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Vol. 28. 505 PEARL STREET, NEW YORK. No 44.

Index to Advertisers and Classified Index Following Reading Matter.

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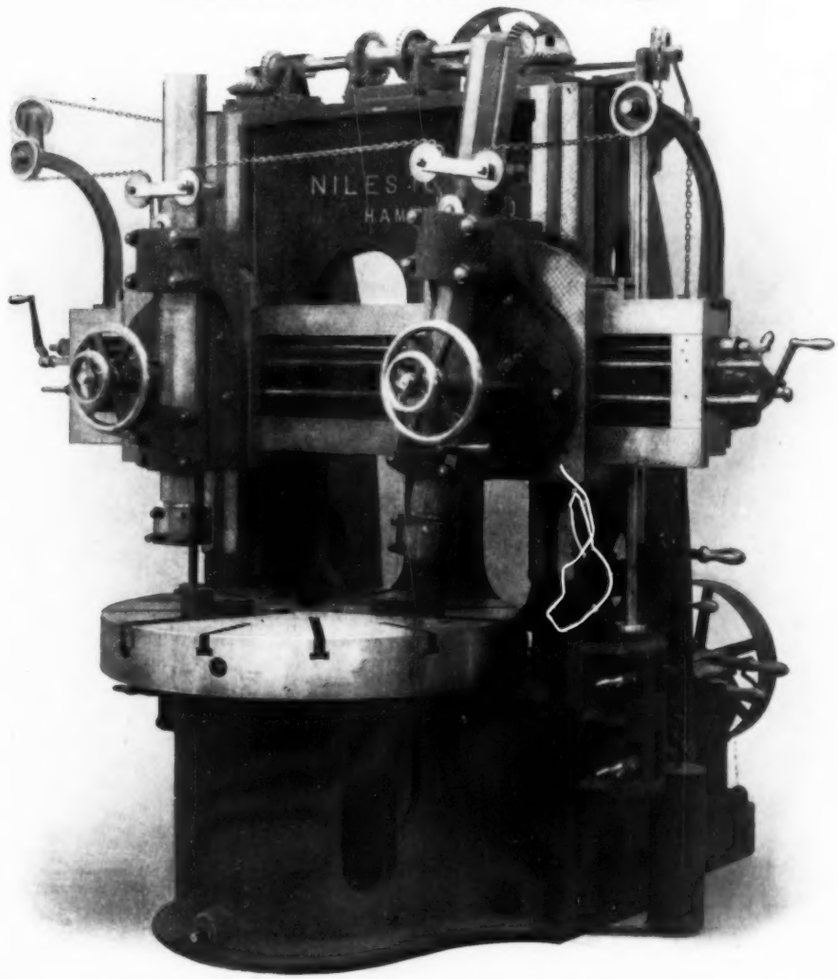

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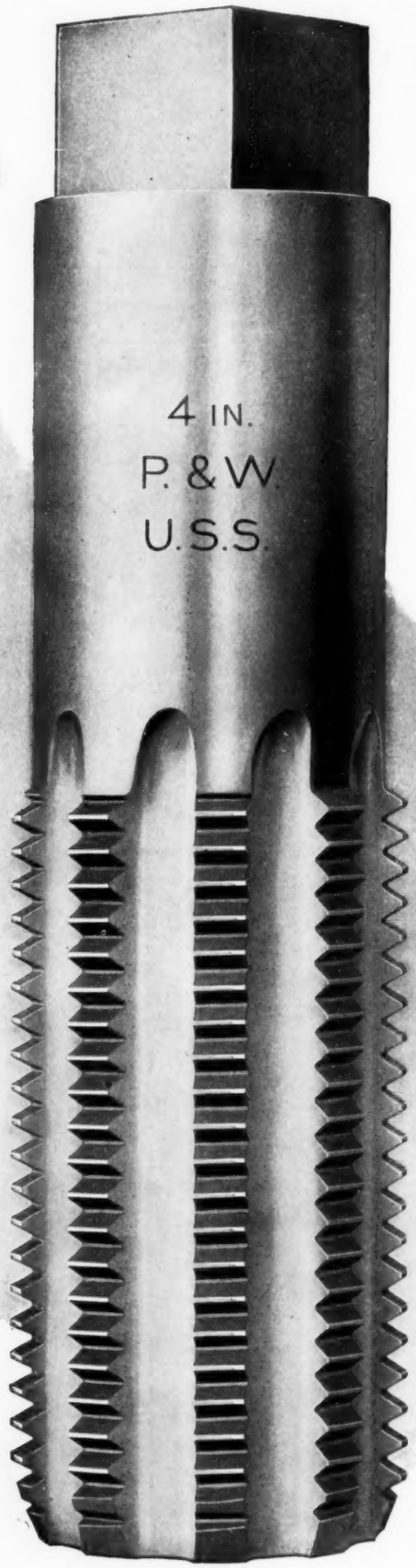

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Some Interesting Generated Worm-Gearing.

At page 1569, Vol. 27, Part 2, we illustrated the gear-cutting and worm-wheel generating machine built by Eberhardt Brothers Machine Company, of Newark, N. J., and we now present illustrations of some interesting work done on that machine.

It will be recalled that the machine uses, in place of a hob, a fly tool ground to the proper angle and set out from the center of the spindle the proper distance—*i. e.*, half of the worm outside diameter plus the clearance, the tool being swiveled to suit the worm thread angle by means of a gage. The cutter spindle is set to the right center distance by a vernier scale on the bed and upright, and is fed tangentially to the work periphery, the tool starting at one side of the blank and traveling sidewise across the face and the blank meanwhile rotating at the proper speed. Single, double, triple, or any multiple thread can be cut, and right- or left-hand teeth are cut by swiveling the tool in the required direction. Ordinarily one pass of the tool across finishes the job, but better results may of course be obtained by taking a finishing cut. The chips that roll out in this process are comparable with those taken on a good, stiff planer.

The great advantage of this process of cutting worm-wheels with a fly cutter, is the fact that worm gearing can be cut correctly, to suit any requirements of centers, ratios, leads, pitch, worm-diameters, etc., because one is not limited to hob sizes.

The machine is shown in Fig. 1 set up for generating the teeth of a large gray-iron worm-wheel, this size of machine accommodating gears up to 84 inches diameter. The fly tool, as will be noticed, is drawn up a little from its proper position in the spindle in order that it may be more clearly seen. The worm-wheel on the table is 50 inches diameter and 2 inches circular pitch; its worm, which is of steel, is 9¼ inches outside diameter, 4 threads, 8 inches lead. A pair of such gears and their worms are shown in Fig. 2.

Fig. 3 shows a gear 63 inches diameter, 2 inches circular pitch, generated to run with a worm 12½ inches diameter, 5 threads, 10 inches lead. As in the preceding case, the wheel is of gray iron, the worm of steel. This is probably the largest worm-wheel ever generated in this country.

The small spiral and worm gears in Fig. 4 show an interesting case of gears in the ratio of 1 to 1. It was found that spiral gears were not sufficiently durable

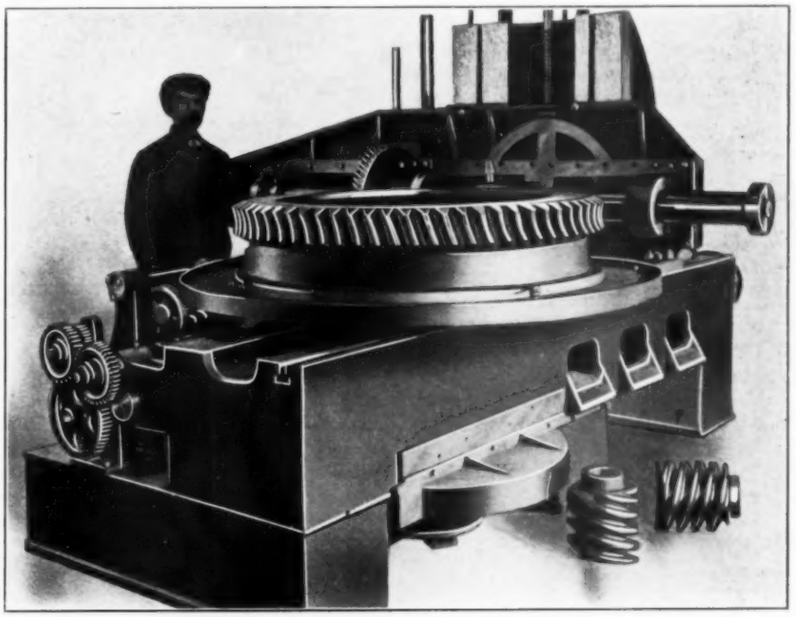


FIG. 1. GEAR-CUTTING AND WORM-WHEEL GENERATING MACHINE.

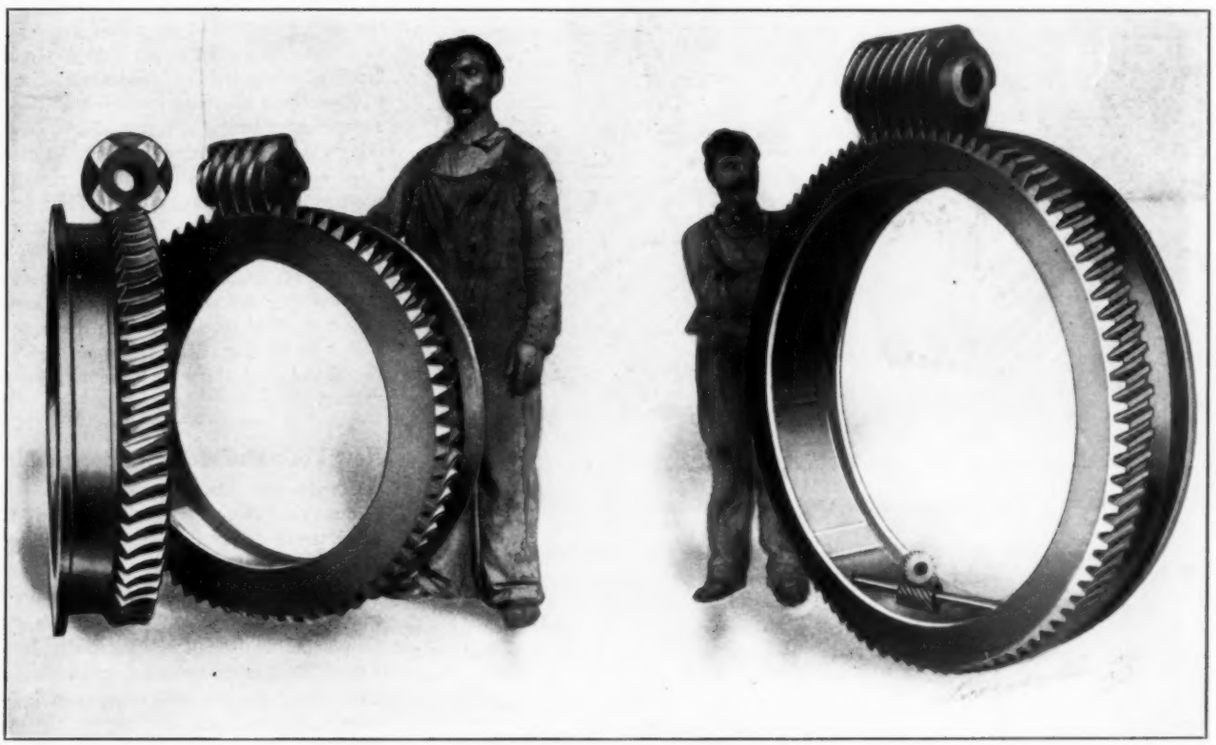


FIG. 2. SOME LARGE GENERATED WORM-GEARS. FIG. 3.

for the work; as with spiral gearing the contact or wearing surface is so small. With worm gearing, the wearing surface is much greater; and it was found that, by making the pair real worm gears, the bearing and durability were so increased as to make the pairs successful. The centers and ratio were kept the same. This change could not have been made commercially, if it had been necessary to make the expensive hob required for such a special case.

In Fig. 5 the worm-wheel, which is about 24 inches diameter, is of phosphor bronze, it being made for severe continuous duty, and the triple thread worm of tool steel. The small worm standing at the side is a special affair cut integrally with the shaft.

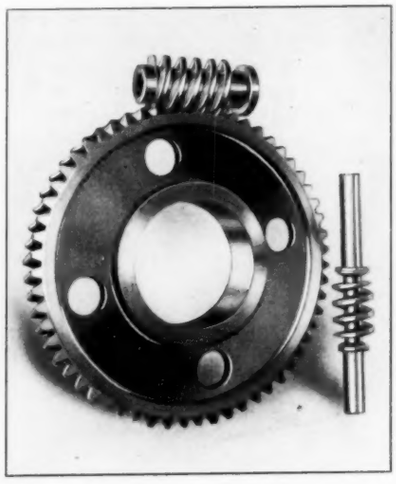


FIG. 5. A GENERATED WORM-WHEEL OF PHOSPHOR-BRONZE.

The Divining Rod Again.

It will be remembered that some time ago we had an article from an English correspondent giving the experience of of an egineering establishment in the employment of a man with a divining rod to locate a well for them. It will perhaps be remembered, also, that our esteemed contemporary, *The Engineering News*, essayed to poke fun at us for the publication of this article, and that the discussion about it eventually spread over the technical press of England. It now seems to have gone into Germany as well, and we find the following (of all places in the world) in the columns of our contemporary above mentioned, under date of October 12:

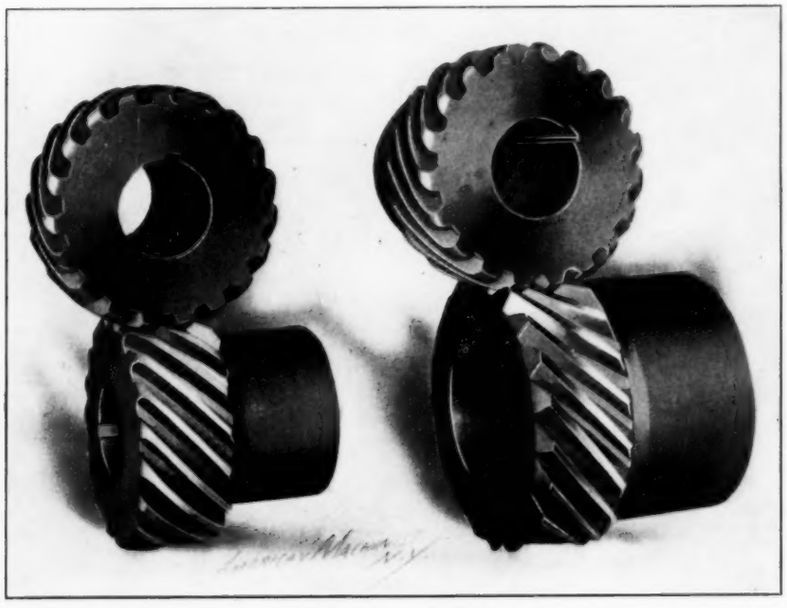


FIG. 4. A PAIR OF 1 TO 1 SPIRAL GEARS AND THE WORM-GEARS THAT REPLACED THEM.

Successful use of a divining rod is reported by G. Franzius, of the German Harbor Construction Bureau, associate director of the construction of the Kiel concrete dry docks, in the *Zentralblatt der Bauverwaltung*, of September 13, 1905. The occasion for a trial of divining-rod performance presented itself a few months ago when it became necessary to sink additional wells on the grounds of the Imperial Navy Yard at Kiel for water supply. In this territory water is found overlying an impervious hardpan, whose upper surface is very irregular. The conditions are such that at one point a bore-hole may give ample water, while a dozen feet away no water is struck, and at still other points artesian flows of low head may be obtained. In order to avoid, if possible, the expense of many trial bore-poles, Mr. Franzius obtained the assistance of one Mr. von Bülow-Bothkamp, who had made a large local reputation as a water and gold finder. The appliance used by him is a piece of iron wire, about ⅛ inch or less in thickness, bent to the form of a loop with long crossed ends; this "rod" is held by grasping in the two hands its opposite ends, which thus serve as axis, and allowing the loop portion to project horizontally forward from the body. When passing over or near an underground flow of water (apparently Mr. von Bülow-Bothkamp is able to indicate only flowing underground water), the loop of the "rod" flies up sharply, striking the operator's breast. Armed with this instrument, the expert first discovered a large underground flow, undiscernible from the surface, but well known to the engineer in location and direction because it had been tapped during the dry-dock work; the expert at once found its course and its direction. Next, at a driven well which had been closed off with a plug some time before, the expert obtained no reaction, in spite of the positive statement of the engineer's assistant that this pipe had given an artesian flow. As proof of the expert's error, the plug was taken out of the pipe, when, lo! no water came. It is thought possible that a well driven some 60 or 70 feet away may have laid dry the flow supplying the first well. The next test, made at the second well, an artesian bore-hole, was for depth of supply flow; the expert guessed 43 feet, which was correct. He next discovered a large flow, suitable for an additional well, and, as the first discovered location was inconvenient, he followed its course some 100 yards to a point where he said water would be struck at 50 feet depth. Subsequently, an excellent well was put down here, with a natural head of several feet above the ground surface. By this time the expert was visibly exhausted, so that work was stopped. At the discovery of the spring last noted, he asked Mr. Franzius and others of the party to touch the "rod" which he held; the former and some of the others claim to have felt distinctly something like an electric shock, while others were insensitive. Mr. Franzius later was able himself to obtain reactions with gold and water, using a bent fresh walnut twig, and also found some among his acquaintances who could, in varying degrees of strength, detect the effects in question. Judging by his signed article above referred to, from which the preceding is taken, Mr. Franzius appears firmly convinced that there is something in the matter.

New York-Philadelphia Electric Line.

Construction has commenced on an electric road from Elizabeth, N. J., to Milltown, near New Brunswick, which will connect with the Camden & Trenton and the Trenton & New Brunswick roads, already in operation, and complete a continuous route from Philadelphia to Jersey City. This, with the opening of the tunnels under the Hudson river, will give a continuous trolley line from Philadelphia into New York city. The new road is expected to be completed early in 1907.

A Large Home-Made Boring Mill.

We illustrate herewith a machine which, for want of a better name, is called a boring mill, although it is to be used in connection with many classes of machine work other than boring and turning. Its construction by the Crocker-Wheeler Company was undertaken in order to provide for the large alternator work which that company has undertaken, and, except for the main table gear, it is entirely home-made. It is to form a portion of the equipment of a new building now under construction, which will be fitted with a floor plate throughout and be devoted entirely to the work of floor-plate tools.

The machine is to have no overhead works whatever, the tools being in all cases supported from the table or the floor, and, as a second leading feature of the design, a central portion, 5 feet 6 inches in diameter, of the table is to be stationary. Of course, in a machine of this character, the extreme capacity is indefinite; but the speeds have been calculated up to 24 feet diameter of work, and hence it may be called a 24-foot mill, although capable of doing much larger work in emergencies.

SCHEME OF THE MACHINE.

The scheme of the machine is shown in Fig. 1, which is a section through the table and its supports. The table *a*, which is flush with the surrounding floor plate, is carried normally by a ring *b*, of which the step bearing is at *c*. Ring *b* is bored parallel, while the support *d* for it is turned conical, a bearing ring *e* being fitted between the two. A key compels this ring to travel with the table, making the cone joint the running joint, and, by adjusting the ring, the fit may be maintained, although with the extremely liberal amount of surface provided, the spindle bearing being of over 5 feet diameter, it would seem doubtful if necessity for such adjustment will ever arise. The upper face of the support *d* forms the stationary portion of the table.

While the table is normally carried by the step bearing *c*, the lower face of the main driving gear *f* and the upper face of ring *g* are formed into a safety bearing, which comes into play when needed. Ring *g* is supported by a series of 32 wedges, which rest upon another ring *b*, this ring resting, in turn, upon an annual concrete pier *i*. When the machine is finally assembled, the wedges will be tightened to contact, and their bolts will then be slacked

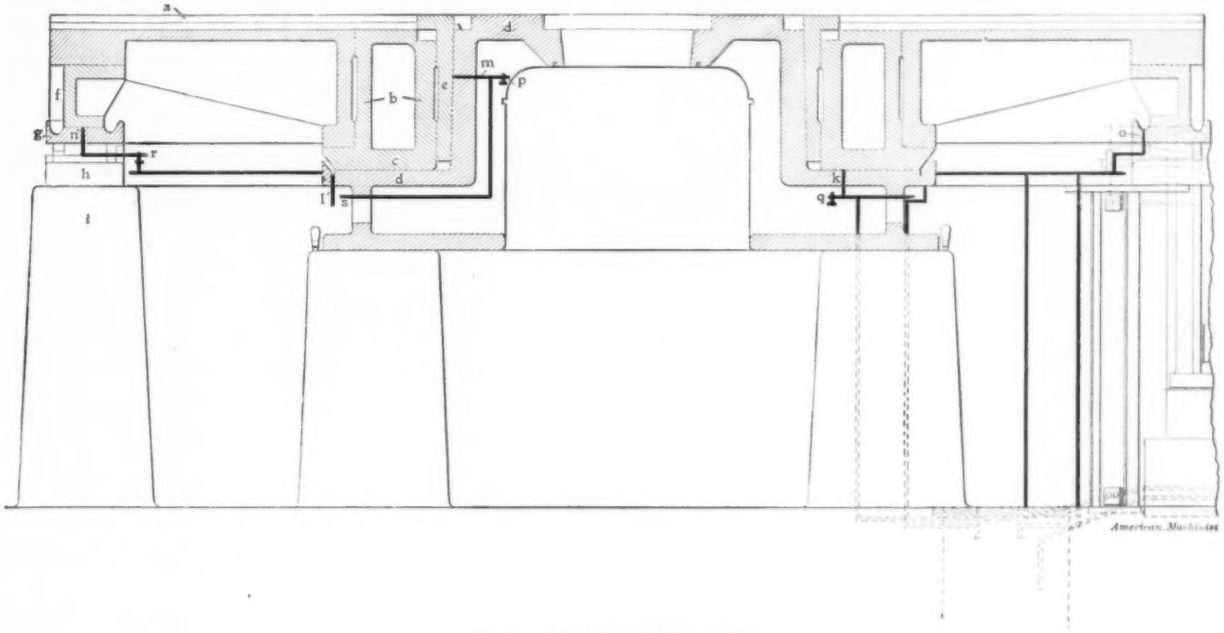


FIG. 1. SECTION AT BORING MILL.

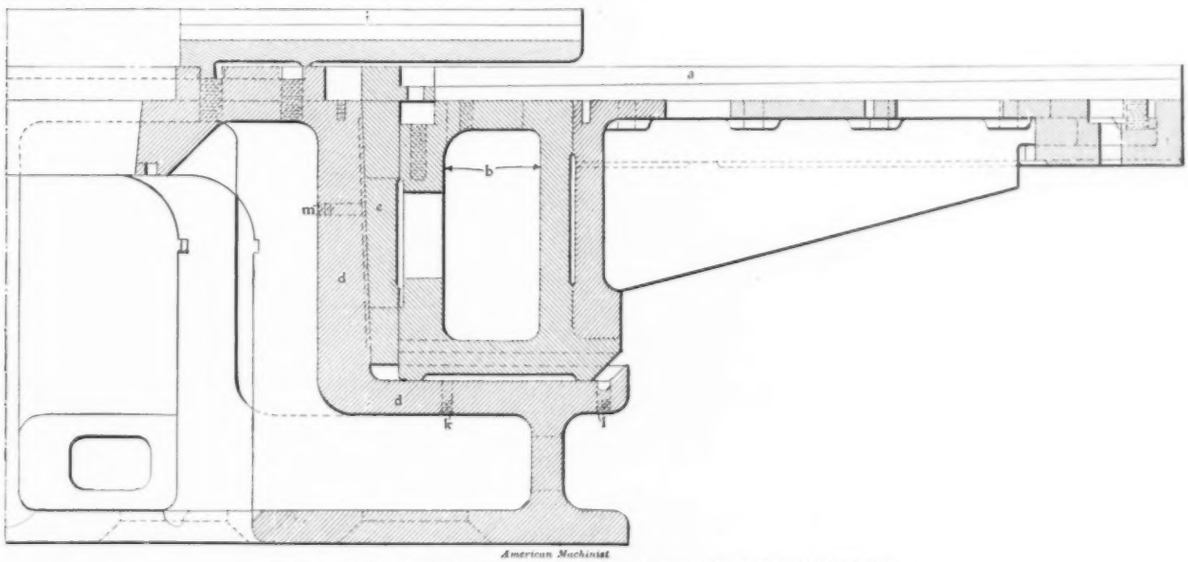


FIG. 2. HALF SECTION, SHOWING SUPPLEMENTARY STATIONARY PLATE.

off by a uniform amount, which will lower ring *g* from contact with *f* by a defined but microscopic distance, and thus transfer the weight of the table to the step *c*, which will carry it except when its load is sufficiently heavy to spring it enough to bring the safety bearing into play. Provision has been made for removing a section of both rings *g* and *h*, in order, after the mill is assembled, to permit the placing of a cutting tool and slide in the pit and the final facing of the bearing surface of the main gear in its working position.

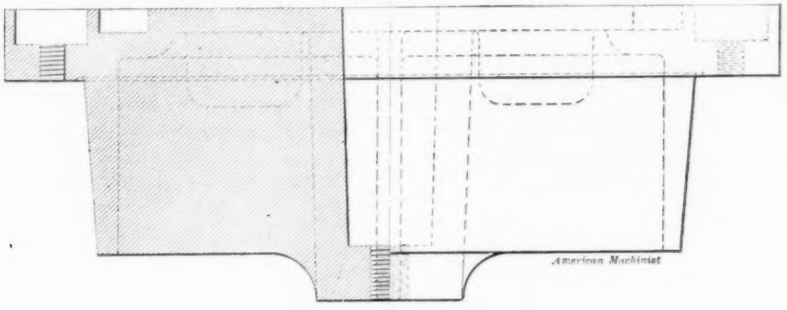


FIG. 3. TRAM PLUG.

When used for boring or turning, the work and tools will be mounted in a variety of ways, thus:

(1) In turning, the work may be mounted on the center or stationary part of the table, with the turning tool on the revolving part. To increase the range of the machine under these conditions, a supplementary stationary plate *j*, of Fig. 2, is provided. It is self-centering, as shown, and by its use the diameter of work which may be turned in this manner is extended to about 9 feet.

(2) In turning, the work may be mounted on the revolving part of the platen with extension pieces, if necessary, the tool knee being bolted to the surrounding floor plate. In this way work may be turned up to the limit of the machine.

(3) In boring, work may be mounted on the revolving part of the platen and the tool knee on the stationary part.

(4) The work may be mounted as in (3), and the knee be placed on the supplementary table, the range in boring being thus materially extended.

(5) In boring the work may be placed on the floor and the knee on the revolving part of the table, extension pieces being used if necessary, the range in boring being thus extended to the limit.

For smaller boring than that to which plan (3) is adapted, as in boring hubs, a boring bar will be placed in the hole through the stationary part of the table. The details of this bar have yet not been worked out, but it will be of the traveling head type, and be driven from below by a special motor.

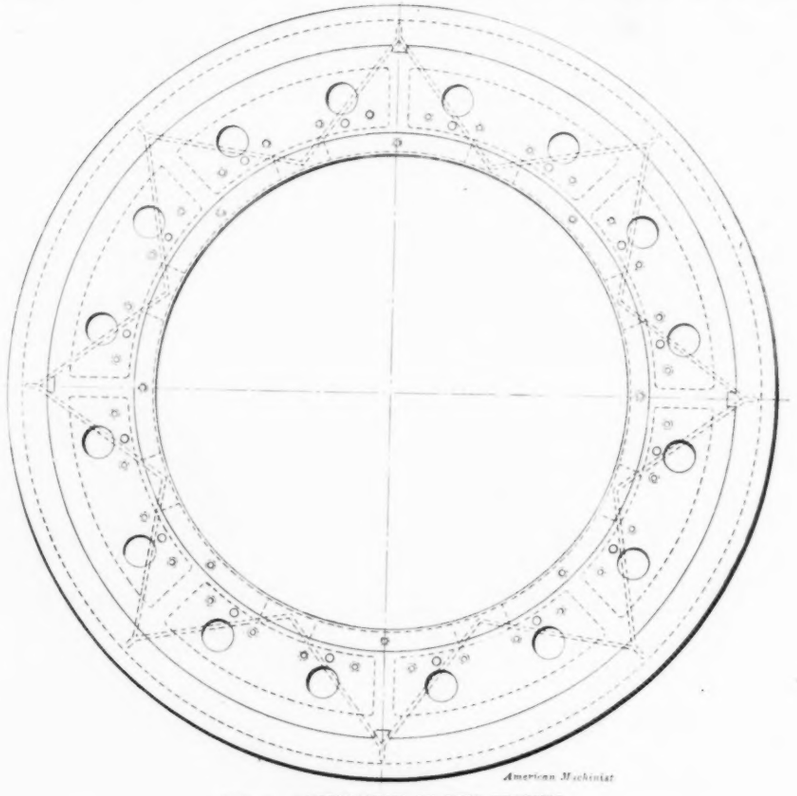


FIG. 4. LUBRICATION OF STEP BEARING.

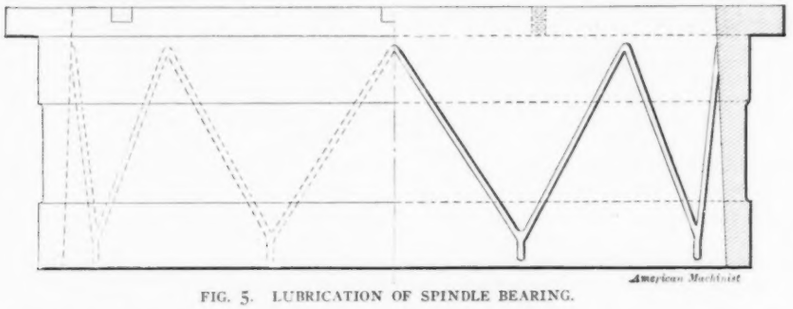


FIG. 5. LUBRICATION OF SPINDLE BEARING.

To facilitate the adjustment of work a plug, shown in Fig. 3, fits the conical hole in the center of the table. It has a socket reamed for a Morse taper, in which a smaller plug carrying a tram may be inserted.

LUBRICATION.

Particular attention has been given to the lubrication, which will be by the forced circulation system. Fig. 4 shows a plan of the ring *b* of Figs. 1 and 2. The step bearing surface will be seen to have a zigzag oil groove around its entire circumference. The support *d* of Figs. 1 and 2 has a series of radial grooves over which the zigzag grooves will pass as the table turns and into them will be tapped a series of pipes as at *k*, Figs. 1 and 2. These pipes will connect to an elevated oil tank, by which the bearings will be constantly supplied with oil under pressure. As shown in Figs. 1 and 2, the step is surrounded by an oil channel, from which a second series of pipes tapped in as at *l* will lead the oil to a filter and pump, by which it is pumped back again to the tank. The spindle bearing has a similar set of grooves, as shown in Fig. 5, and is fitted with a similar pipe system tapped in as shown at *m*, Figs. 1 and 2, and the safety bearing is similarly treated as indicated at *n* and *o*, Fig. 1. A feature of the oil-pipe supply system is the insertion of a pet-cock in each branch as near as possible to the bearings, as indicated at *p q r*, Fig. 1, by which in case of stoppage of the

pipes the location of the obstruction may be determined.

The supply of oil to the spindle and step bearing is by a ring main, located at *s*, Fig. 1, and shown complete in Fig. 6, *a a* indicating the location of pet-cocks *p* of Fig. 1 and *b b* indicating cocks *q*. The supply from the pump connects at *c*. The safety bearing has a similar supply ring at *r*, Fig. 1, and the return pipes are connected in the same manner.

To provide for renewal of the table surface, in case of serious damage after long use, false pieces, shown in Fig. 7, are bolted to the table, the T-slots being formed by the spaces between them.

USE OF PORTABLE TOOLS.

As said above, the mill is to be used in connection with other work than boring and turning. Large alternator work involves a good deal of slotting, milling, drilling and tapping around the circumference of the rotors. The work will be done by a series of portable tools, while the pieces to be machined will be mounted on the table of the mill and may thus be turned step by step and presented to the tools in a proper manner.

put in place, and Fig. 10 shows the table in position, together with the location and construction of the driving motor and gearing. The table has 36 speeds, ranging from .33 to 3.355 revolutions per minute. The motor is of the multiple-voltage construction, and has 18 speeds, which number is doubled by the back gear. The concrete piers shown are to support the floor-plate. They give abundant access to the pit below the machine, which will be provided with stationary

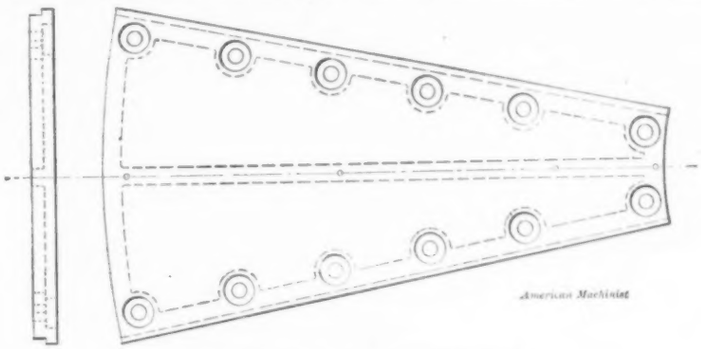


FIG. 7. SECTION OF TABLE-SURFACE PLATE.

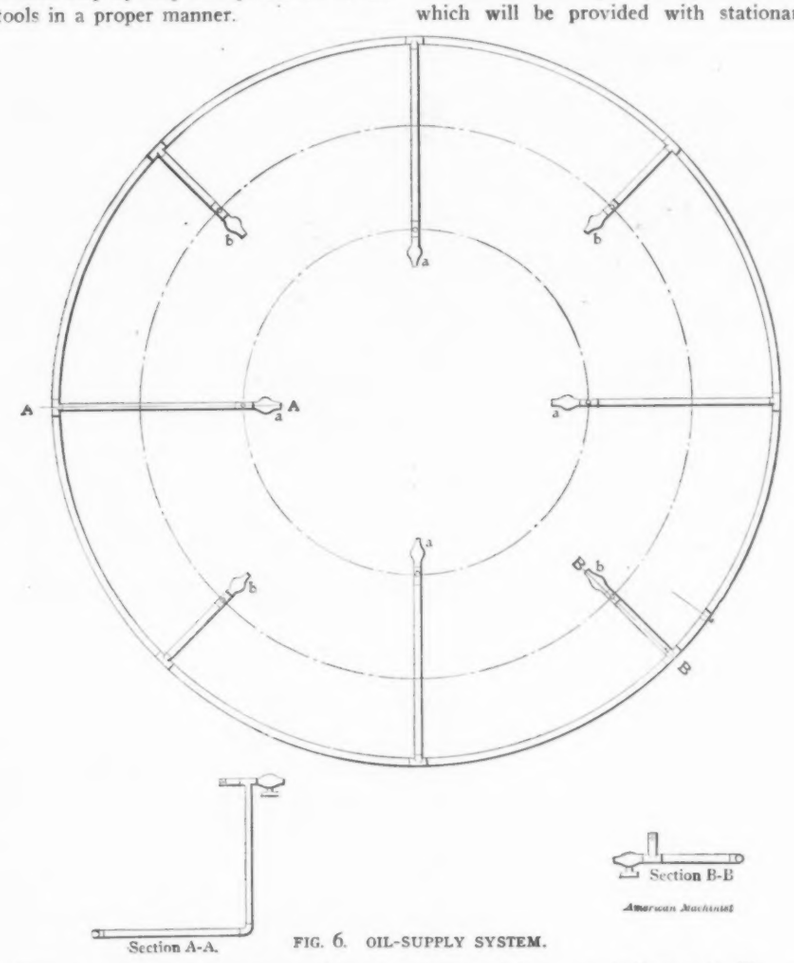


FIG. 6. OIL-SUPPLY SYSTEM.

Figs. 8, 9 and 10 show the machine in process of erection. Fig. 8 shows the spindle, the step and the safety bearings, with the wedges under the last named; Fig. 9 shows the machine after the piece *b* and the taper ring *e*, of Fig. 1, had been electric lights. As indicated in Fig. 10, after the floor-plate is in position, nothing will show above it. The surface of the table being flush with the plate, it will appear as a circular revolving section of it, with nothing more to be seen.

The Liability of the Patternmaker.

BY J. L. GARD.

There does not seem to be any clear understanding among foundrymen, patternmakers, and machinists as to where the patternmaker's responsibility ends. Does it end with the pattern, or does it extend through the foundry until the casting is made and on through the machine shop until the machine is completed and in operation, and then till the machine is sold and the customer is satisfied, or does it end with the pattern? If the pattern is made to the best of the patternmaker's ability and the customer inspects it and it is turned over to him, and he sends it to the foundry and a casting is made from it which does not come out right because the patternmaker has omitted something that he failed to see is needed, the customer fails to see the omission, and then has it machined, after which he discovers an essential part lacking, should the patternmaker correct the pattern, pay for the casting and the machine work, or should he only be required to make the pattern good? There must be a limit at some point where his liability ceases, but where is it?

I am moved to write this by a recent happening of this kind. I made a cylinder pattern and core-boxes for a jacketed cylinder to replace a worn one, having the old casting to work by, that had no jacket on, and verbal instructions for the changes to be made. The bore was to be smaller and the outside to be the same diameter as the old one. There was a port running the full length on the top side, that must be a separate opening from either the bore or the jacket. The jacket core was made in sections and a stop-off piece put in for the two cores next the port.

I failed to locate this stop-off piece properly and the jacket core contacted with the port core, leaving no metal between. The fact that it was so located that it would not leave a division was not known by me or the customer when he inspected the pattern. The machinist did not discover it. It was returned to the customer to put on the machine to which it belonged, when the men doing so discovered it. They sent for me to look at it, and asked if I knew why it was so. I said I

did not, but I did not think the error was mine because I had carefully checked over the pattern twice, but that I would not say positively until I had seen the pattern and casting together. They sent for the pattern and we began to measure it up, and found it was an easy matter to find the error when we knew it was there, and I showed them the discrepancy.

They told me they would expect me to correct the pattern, and pay for the casting and the machine work. This I thought was rather rubbing it in, and I objected. After much argument they finally conceded that they would stand the cost of the machine work, as they admitted that they should have inspected the casting before it was machined, but still insisted that I should get them a new casting. The matter rested a few days. I then suggested to them that they plane off the port part of the cylinder and make a separate casting for the port opening and bolt it on. They agreed it would be practical, as it gave them water space around the port that they did not have before, which would be an advantage. This would be all right, but I must stand all the expense. I demurred to this, as I considered that they were partially responsible, but I proposed to make a pattern and furnish them a casting for the port opening and they machine it and put it in place. They could machine the port casting in their own shop, but would have to send the cylinder out for machining. They would not consent to this and insisted that I either do the whole job or get a new casting.

Failing to agree on the repair proposition, I then offered to buy from them the spoiled cylinder at its actual weight and at the price per pound they had paid for it. They would not listen to this, but insisted that I not only must pay for the iron in the defective casting, but also for what they had machined off. I objected to paying for something that they could not furnish me, and asked if the removal of the iron was not what the machine work consisted of, and if they were liable for the machine work, why were they not also liable for the stock removed? But they would not see it, and again insisted that I must pay for a new casting. I contended that I had nothing to do with a new casting, and that they could only claim compensation for what was defective, and that, as they had inspected the pattern and taken it and used it, they had accepted it, and that I was not sure they could hold me for any of it, but that I was trying to do the right thing and wanted to meet them reasonably, and had conceded all that I thought they had any right to ask. I then tendered them the cash for the net weight of defective casting, which was refused. As they owed me an amount greater than the cost of the casting, they seemed to feel that it was not necessary to do anything. I left them with the matter unsettled and with the intention of bringing suit for the amount due me.

Many other things claiming my attention, I did nothing about it during the next week, but again called on them, hoping that a settlement might be reached. They said that they would stand pat for a new casting. I replied that I had gone the limit on my previous proposition, and that I thought I would have to bring suit for what was coming to me. But I said: "Now, look here, are you going to be sued for the sake of a few dollars? I will make you one more proposition; I will meet you half way between your proposition and mine, and you want to think quick about it."

We settled on that basis. I bought the defective casting, paying them some $12 more for the casting than I received for the pattern. While I have had these things happen before, I have never been up against as hard a proposition as this proved to be.

It would seem to me that I should not have been required to pay for this casting. First: because when they asked for an estimate on the pattern, they said they would only use it once and wanted it made as cheaply as possible; and they certainly did not expect me to figure on anything but the making of the pattern, as they did not ask me to guarantee a perfect casting from the pattern, nor did they tell me that I would be responsible for any poor casting. Second: because when I had completed the pattern I had them and the foundryman both to look it over;

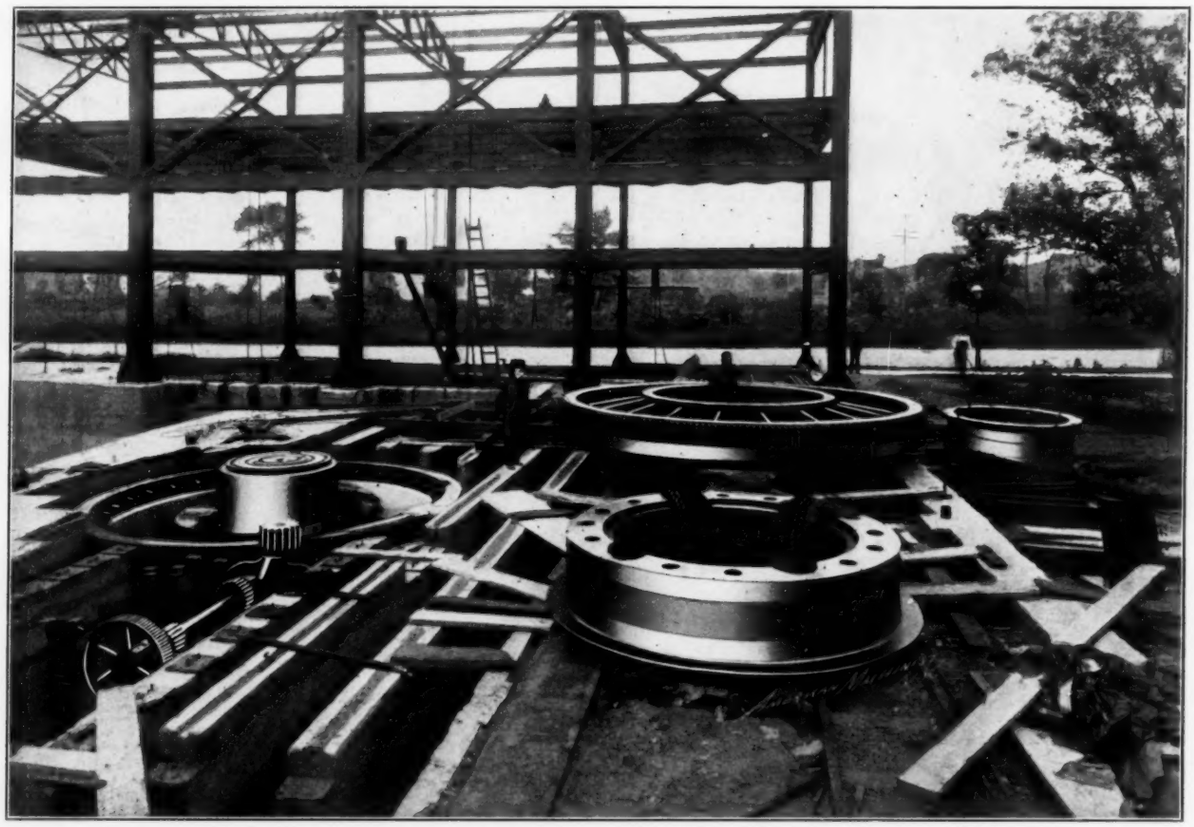


FIG. 8. THE MACHINE PARTLY ASSEMBLED, SHOWING SPINDLE, STEP AND SAFETY BEARINGS.

I explained to them what each piece was for and how used; they saw nothing wrong with it any more than I did, and the foundryman took it away and used it; but as I said before, it was easy to see the error when we knew it was there.

I have treated the business side of the question, but I also think there is a moral side to it. They were repairing the machine to sell, and in some of the conversation told me that they would probably make a profit of $1,200 on the transaction. They would have some opportunity to recoup their loss, while I had absolutely none, but must pay for having done their work, which I did by buying 1,800 pounds of scrap iron at casting prices. There was no question whatever about making the pattern right, as that was done the same day the error was shown to be in the pattern. I now use a tag worded as below and put it on all patterns sent out. I suggest that it be printed, as I believe it would be of interest. If we do not learn by experience we are living in vain. I do not doubt but other readers have had thinks like this happen.

TO THE CUSTOMER.

When you receive patterns from me you MUST check them up, and discover any existing error. I am not infallible, and even others are likely to err. I will, at any time, gladly correct any error free of charge on any pattern of my making. I do not expect to shirk my responsibility, but I will not assume yours, or that of the foundry. MY responsibility is for the pattern, and SHALL NOT extend farther.

It is expressly stipulated that you accept patterns under these conditions. Use care to prevent errors. It costs less than to correct them. Patterns are sent you with the belief that they are right, but I insist that you prove them so. Therefore, check up this one, and every other one you get, whether tagged or not. J. L. GARD.

FIG. 10. THE TABLE-DRIVING GEAR AND MOTOR.

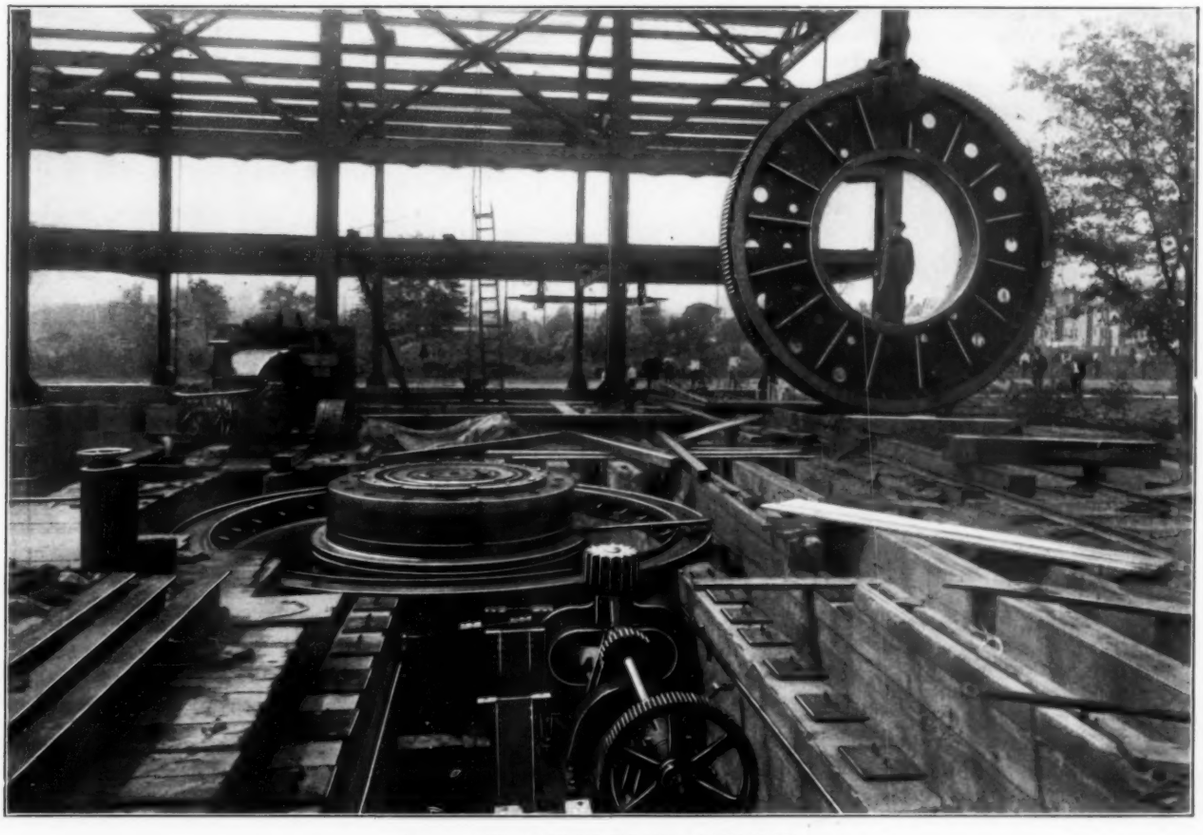


FIG. 9. THE MACHINE FURTHER ASSEMBLED.

Lang's Lathe Works at Johnstone, Scotland.

BY J. WILLIAM CHUBB.

In machine-tool practice, as in other branches of engineering, the tendency is necessarily to specialties, but in Great Britain there is a further tendency for a firm to confine itself solely to the manufacture of a single type of tool. The firm of John Lang & Sons, Ltd., Johnstone, Scotland, only just misses doing this, for almost, but not quite, all their energies are devoted to the manufacture of lathes and the accessories, such as mandrel presses, which accompany the use of the lathe. The firm started some thirty-one years ago, and is at present formed of the original founder, who supplies the name, and his four sons, all of whom are actively engaged in the business, each devoting his attention to some particular branch. It is an example of natural growth, having started with the proverbial man and boy in a single room. This was soon outgrown, and the business has gradually extended, until comparatively recently a plot of land of more than 15 acres was taken, on which the existing works and offices now stand, the plot affording plenty of room for extensions which, indeed, have been plotted out. Moreover, the open-door policy prevails, the firm advertising its readiness to show visitors over its works.

AMERICAN MACHINIST readers will not need to be reminded of the special work of J. Lang & Sons in lathe design. They will remember their special form of bed, with longitudinal guide and adjustment strip, which gives a guide about ten times the width. Then the sliding key arrangement for quick change-feed motion was also patented by the Scottish firm, and, more recently, the advantages of a constant cutting speed on the tool, independent of the diameter of the job under treatment, were very keenly recognized by the firm, as a reference to a special article appearing at page 509, Vol. 27, will show. Then, again, always wishing to provide ample belt power, the firm in its large cone lathes places the pulleys on the back shaft separate from the main spindle, a practice, however, in which it is not quite alone.

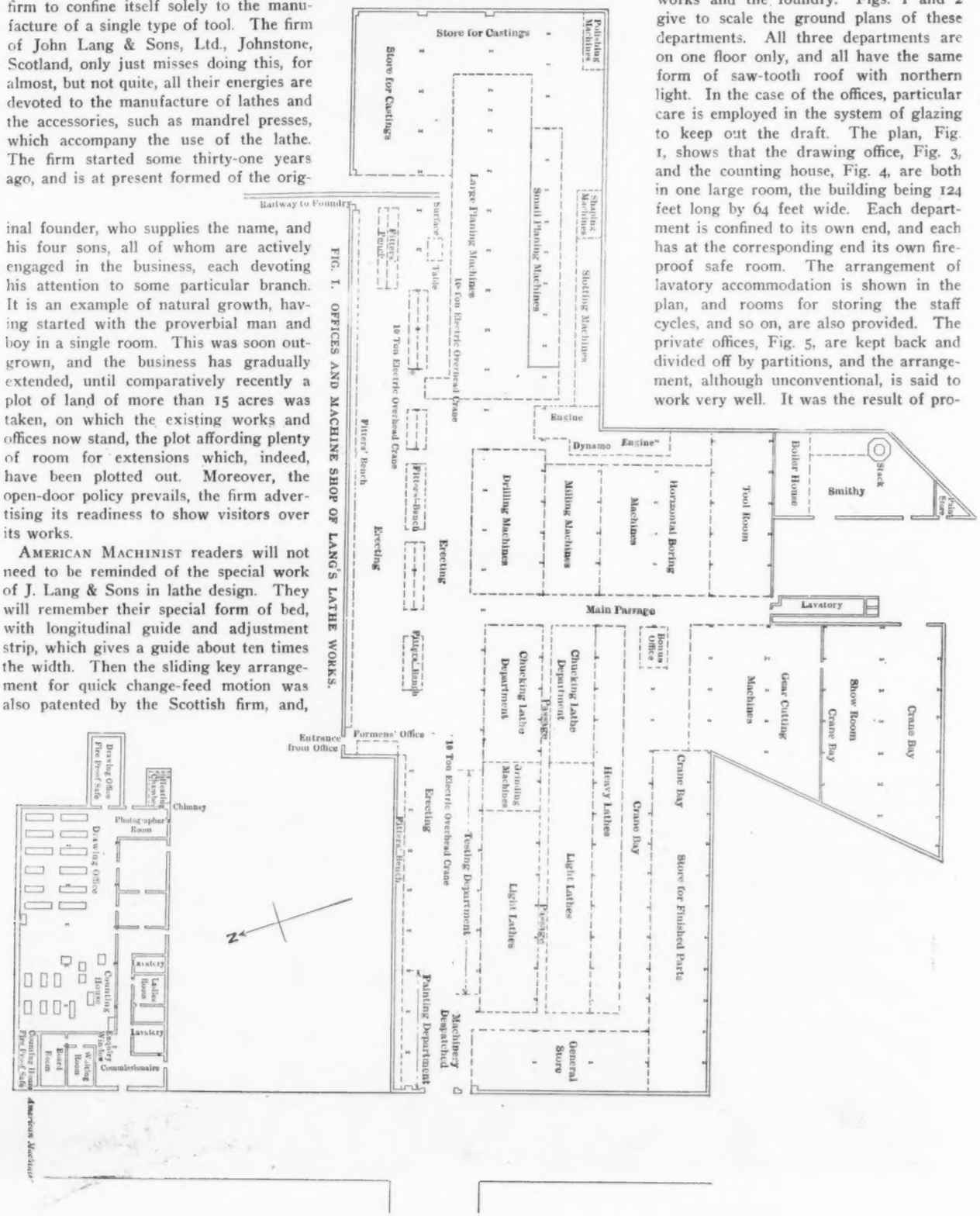


FIG. 1. OFFICES AND MACHINE SHOP OF LANG'S LATHE WORKS.

THE OFFICES.

Apart from the old factory and offices, now disused, the main buildings in Mary street, Johnstone, are in three sections, containing, respectively, the offices, the works and the foundry. Figs. 1 and 2 give to scale the ground plans of these departments. All three departments are on one floor only, and all have the same form of saw-tooth roof with northern light. In the case of the offices, particular care is employed in the system of glazing to keep out the draft. The plan, Fig. 1, shows that the drawing office, Fig. 3, and the counting house, Fig. 4, are both in one large room, the building being 124 feet long by 64 feet wide. Each department is confined to its own end, and each has at the corresponding end its own fireproof safe room. The arrangement of lavatory accommodation is shown in the plan, and rooms for storing the staff cycles, and so on, are also provided. The private offices, Fig. 5, are kept back and divided off by partitions, and the arrangement, although unconventional, is said to work very well. It was the result of pro-

longed discussion among the principals, each of whom drew out separately a plan to his own ideas, these plans being then compared and discussed, the good points of each taken out and embodied in further plans, from which the arrangement was finally made. A specially recognized advantage of the one-floor system is that it implies no stairs. Movement on the part of the principals and heads of departments from one section of the premises to another is, therefore, not tiring. The roof arrangements, combined with the direction of the buildings, give in the offices an exceptionally good light, the direct rays of the sun entering at the ends only. Both safe rooms are fireproof and well ventilated, hollow walls with a 2½-inch space being provided to keep out the damp, while radiators in the drawing-office safe room maintain constant temperature. The photographers' room adjoining is equipped with the usual appliances, including electric blueprinting machinery. The rack system is used for drying, the prints being held by rollers at the end and the water thus running off by gravity. The office is heated by hot-water pipes and radiators, and the heating chamber is shown on the plan. All the buildings are laid out with a view to extensions, and the present construction of the offices has been so arranged that in the future they can be used as a workshop if required.

THE FOUNDRY.

A plan of the foundry is given in Fig. 2. It has been placed at the northern end of the plot with a siding from the railway from Glasgow to Greenock. The main building is about 250 feet long by rather more than 150 feet broad, and is divided into five bays. From the floor to the eaves is about 26 feet and to the ridges about 43 feet 6 inches. The foundry is exceptionally light, the glazing being ¼-inch rough cast plate glass having a wire mesh cast into it for strength. For ventilation special arrangements have been made with a view to the free passage outward of dust, heated air, etc., while the entry of rain or snow is prevented. Connection with the engineering works is to be made by a special narrow-gage railway, so that the castings can be readily transferred from the foundry to the shops. The building is on the now common steel skeleton principle, at any rate on three sides, where steel pillars form the main support for the roof, with panels of 14-inch brickwork. The fourth wall is of 14-inch brick on a concrete foundation. The bays are formed by rows of H-section steel joists embedded in concrete and bearing at the top 12x6-inch steel H-beams. Over each of two bays runs a 10-ton electric traveler, and in addition a number of jib cranes are bolted to the steel pillars, the arrangements being clearly shown in the plan. The foundry and offices are lighted electrically, 10-ampere arc lamps being used in the first department, while for the en-

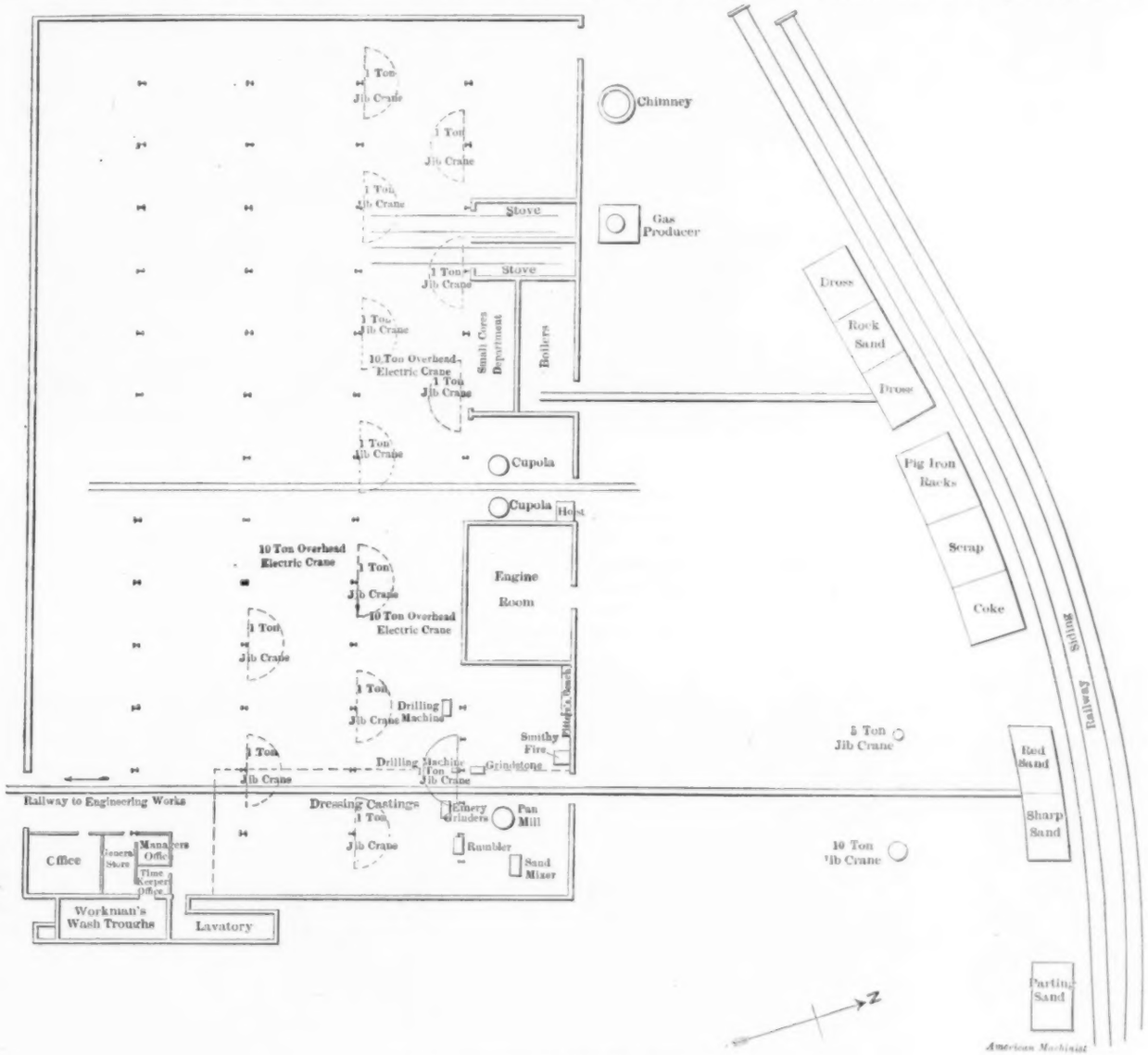


FIG. 2. FOUNDRY OF LANG'S LATHE WORKS.

gine-room and offices generally 16 candle-power incandescent lamps are employed. For this purpose have been provided a 40 horse-power horzontal Tangye engine driving a dynamo, with a Penman boiler of the Lancashire type and Weir feed pumps and feed-water heater. These need not be described further, but it is permissible to say that the boiler-room and the engine-room are bricked off from the rest of the foundry and that over the boiler-house a floor is provided on which patterns are stored. Access for fuel to the boiler-house direct from the railway is shown on the plan.

The foundry floor has a mean depth of about 4 feet 6 inches of sand and, although the drainage arrangements will permit it in the future, no pit is at present provided as the castings are comparatively shallow. In the construction of the foundry the same principle is used as in the main building and, so that this department may be kept in proper order, everything in it, including windows, etc., is cleaned once in six months. The office for this section, shown in Fig. 2, is temporary and will at some future date be outside the building. It will be noticed that washing accommodation is provided for the workmen and the endeavor of the firm is constantly to keep the worker in good health, the conditions of employment being arranged to that end. Every encouragment is given to the men to become abstainers, although no real pressure is exerted in this direction.

A good deal of plate molding is done for the small work, and Samuelson machines are in use. Pridmore machines are also installed. Through the foundry a system of portable rails on the Hudson system will be found, these being in 15-foot 90-pound sections with a 2-foot gage. The trucks will each carry about 3 tons. By these means castings are removed to the dressing and other departments. Sturtevant rumblers are in use with an Evans 6-foot pan mill and a belt-driven Eberhardt sand mixer which will treat about 150 cubic feet an hour. Special core-making machines are also used. Close by the emery grinders in the plan will be seen an ordinary grindstone with drilling machines, smithy fire, and fitters' bench, these being used for keeping the plant in order. To produce the necessary blast a belt-driven Sturtevant blower is employed, this being placed in the engine-room and driven through countershafting at about 2,200 revolutions a minute. Pressure up to 28 inches of water is thus obtained. Space is provided for two cupolas. For the plant in use a 15-hundredweight hoist, driven by belt gearing from the engine, is provided, this lifting the material direct to the charging platform. To prevent accidents special but simple means are provided. Should a bar project too far over the floor of the hoist, it meets a fixed slanting cover standing out about a foot, which thus pushes it in. The single cupola in use has a melting capacity of about 6 tons an hour and is of about 5 feet outside diameter by about 20 feet from floor level to charging door. Internally it is about 2 feet 8 inches in diameter. By a special arrangement the air is circulated round the cupola two or three times before being taken to the tuyeres, the blast being heated before it reaches the melting zone. Then, in addition, the hearth is small, with a correspondingly small bed charge, so that hot fluid iron is produced rapidly with a minimum of fuel and of blast. Instead of fire-brick, hollow cast-iron lining is used for the upper part of the cupola and reduced up-keep is claimed for this. The charging platform has an iron-plate floor and is under cover, a stairway providing access to it. Two gas-heated stoves are employed for drying purposes, a Hyslop producer being placed outside the building to supply the necessary gas. Each of the large stoves is about 9 feet high by about 30 feet long by 10 feet wide, 14 inches of

FIG. 5. PRIVATE OFFICE.

FIG. 3. DRAWING OFFICE.

FIG. 4. COUNTING HOUSE.

brick being provided for the side walls and 18 inches of brick for the center wall. The doors are of ¼-inch steel plate, with steel angles, and they are hung over the front by wire ropes bearing counterweights, guide rails at the side keeping the doors in position. The waste gases pass from the stoves into the main flue to the chimney. This is about 100 feet high by 4 feet 3 inches inside diameter. In addition small core stoves of a portable type are in use and can be placed in any required position.

Outside in the yard, and facing the railway, storage is provided for raw materials, supplies being brought direct from the wagons, which, obviously, if required, can also remove any loads. The coke, brands of pig iron, etc., are arranged in stacks, notice boards on the ends of the foundry showing the exact material in front of them. The pig iron is brought in 100-ton lots.

The work of the foundry is of course mainly the production of castings for treatment in the machine shops, but outside work is also undertaken, the maximum weight being about 10 tons. Besides being advantageous as giving fair certainty of prompt delivery, the foundry gives the firm control over the castings, so that the quality may be assured. All the iron castings needed by the firm are therefore produced here, lathe beds up to 35 feet long being cast. The work for the firm alone implies a production of 150 to 180 tons a month. Figs. 6 and 7 illustrate the flasks used, which form a special feature in the work of this department. Fig. 6 shows the box open, arranged for molding a fixed headstock. Fig. 7 shows the box closed. Obviously the top, bottom and sides all come apart, and for fastening are jointed and held with catches. The same kind of box is of course used for other jobs.

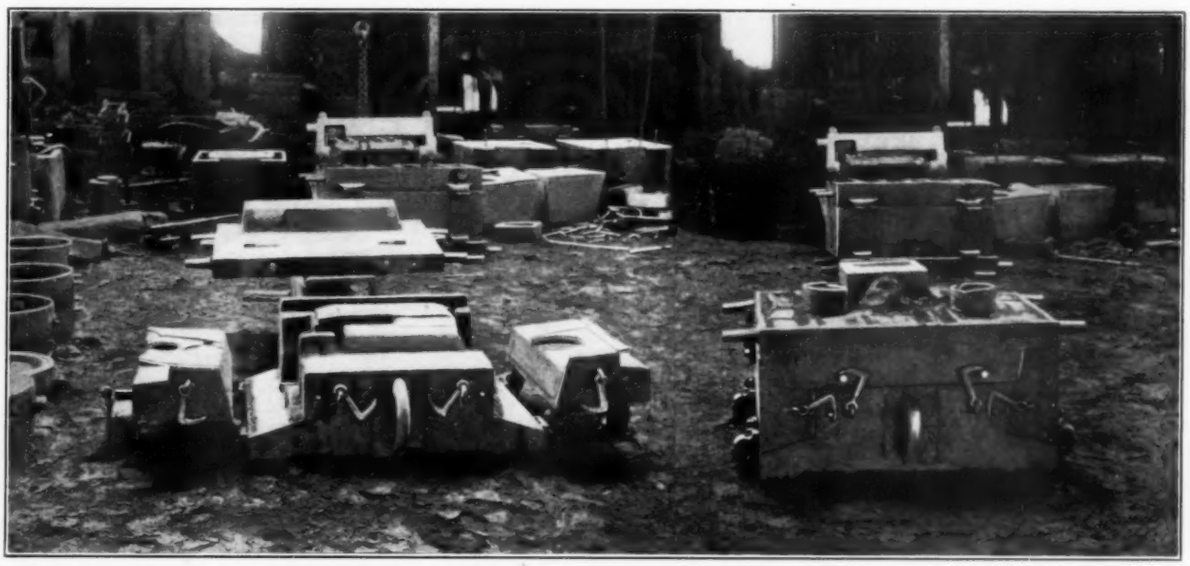


FIG. 6. SPECIAL FLASK OPEN.

FIG. 7. SPECIAL FLASK CLOSED.

THE MACHINE SHOP.

The main works are to the south of the offices, and cover an area of about 10,000 square feet. They contain about 200 machine tools of various kinds, all in operation, and the firm employs a total of about 600 men. The principle of construction is much as that described in connection with the foundry, the main portion of the building consisting of five bays, two 30 feet and three 25 feet wide, with an extension at one end of four bays, and a further extension at the side also of four bays. The same idea of weaving-shed roof with northern light is employed. Fig. 1 may be referred to for the general arrangement and set-out of the building. The object in view has been, of course, to provide the shortest circuit between the entry of the rough material and the exit of the finished product. For driving purposes two engines are put down in the shops, an 80 horse-power dynamo being used for lighting and power purposes. Current is transmitted by overhead wires across the ground intervening between the main works and the foundry, so that the engine in the latter may at times be employed for nothing but blowing. A railway is to be made, as shown, from the

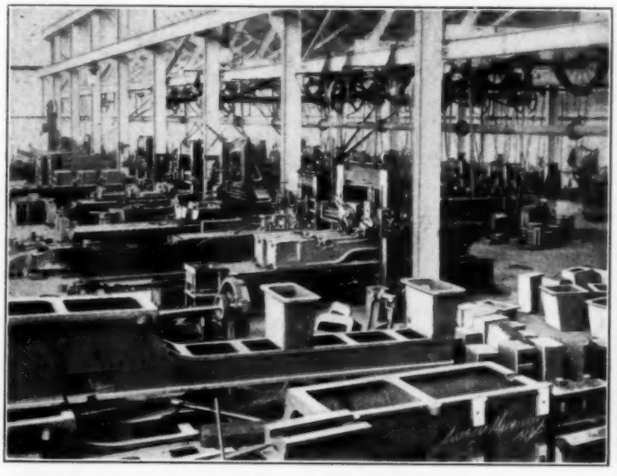


FIG. 8. PLANING DEPARTMENT.

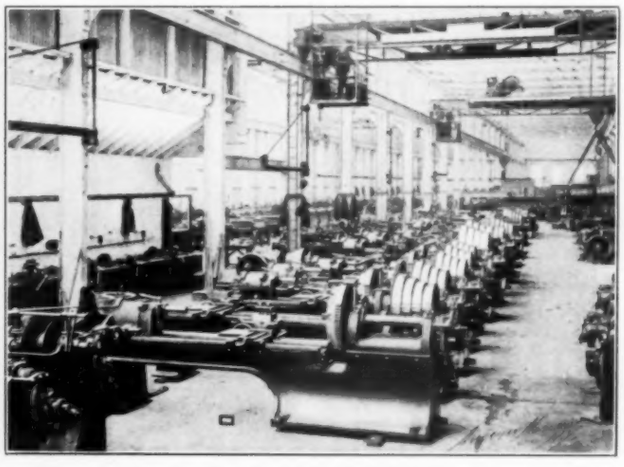


FIG. 9. ERECTING DEPARTMENT.

fitters' department to the foundry and is to pass the blacksmith shop when further additions have been made, the patterns in the same way being placed near the foundry. In view of extensions on one side, a temporary side wall has been built of brick, resting on wood beams, which in turn are supported on concrete foundations, these bearing pillars also. Brick-

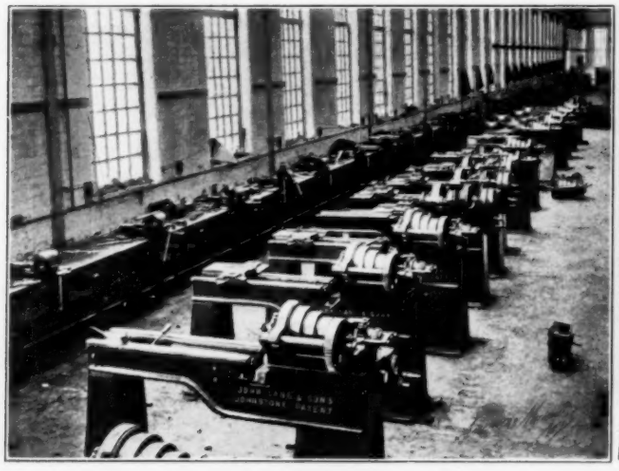


FIG. 10. ERECTING SMALL LATHES.

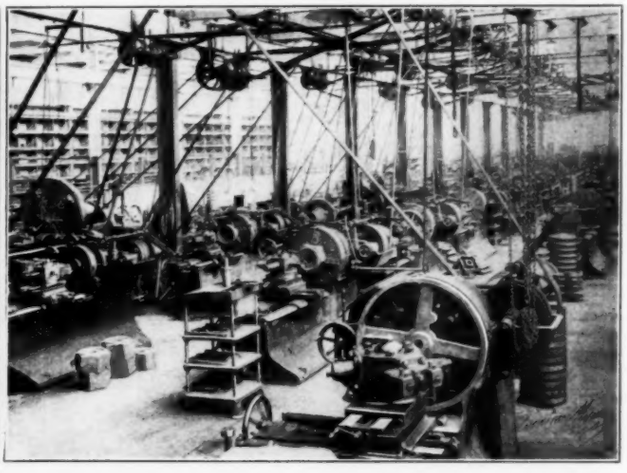


FIG. 11. SMALL LATHE DEPARTMENT.

work is used rather than corrugated iron, with a view to the comfort of the workmen. Two further bays nearer the foundry are to be erected, and then will come the blacksmith department. The old brickwork from temporary walls, when broken small, is employed in preparing the concrete foundations. Generally the machine shops are open, and as few corners as possible are left. The machinery completed is despatched at the front of the building, where will be found the painting department. At the back of this are the erecting and testing departments, 500 feet long, served by 10-ton cranes. At the far end are the large planing machines and the store for castings. The general stores are toward the front of the building, with stores for finished parts at the adjacent side. In the extension to the main building are the slotting, shaping and planing machines—in fact, all the straight cutting machines are in one section of the works, the larger planers being under a 10-ton crane, with the smaller machines at the side. Here, as throughout the works, both British and American tools are employed, but the lathes in use and many of the other tools are of course of the firm's own manufacture. The planers are situated in line with the sending-away department for the convenience of the fitters, while the erecting department is so arranged that the parts from the various machine rooms are put together and finished at the side in sections and then collected and erected. A view of the planing department is offered in Fig. 8, the larger machines being shown to the front, and the smaller ones behind. This illustration, however, represents only a portion of the department, a further set of planers being at the right of the illustration. Two bays of the erecting shop, with a row of lathes in position, are illustrated in Fig. 9, some of the machines in front being of the firm's high-speed type, which have large cone pulleys on a back shaft. This shop is about 500 feet long by 62 feet wide, and is served by two 10-ton cranes of the three-motor type. Longitudinally they will travel at 30 feet a minute. Fig. 10 shows a number of small lathes being put together. Toward the center are three machines with the firm's special drive, which provides a constant cutting speed whatever the diameter of the material under treatment. Departments for light lathes and for chucking lathes are behind the testing department, a section containing grinding machines being also provided. Landis and Brown & Sharpe tools are used in the last department, all turned work being finished by grinding to micrometer and Newall limit gages. Fig. 11 shows the bays devoted to light lathe work, with heavier lathes and the stores for finished parts at the back. This view is taken from the chucking department, and it illustrates the absence of counter motion on the firm's lathes with special variable feed drive. All the chucking lathes are furnished with hexagon turrets. High-speed steel of various makes is of course employed, and a special bonus of-

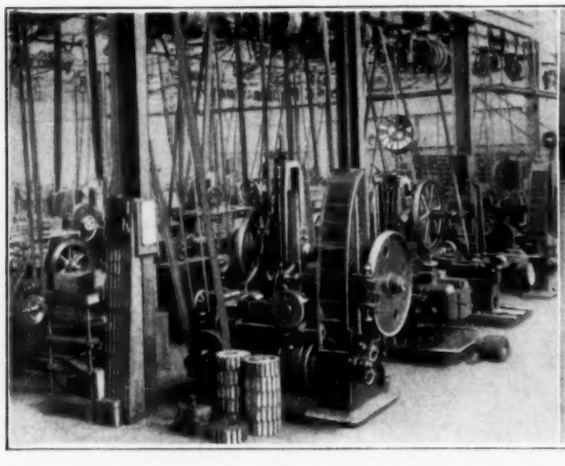


FIG. 12. GEAR-CUTTING DEPARTMENT.

FIG. 13. BORING DEPARTMENT.

fice is placed in this department, the works being run on the premium system. Complete card records of all processes are regularly kept.

The gear-cutting department, illustrated to some extent by Fig. 12, is at the back of the bonus office, the acute angle formed by the outlines of the building cutting into it. This branch of the engineering industry was introduced systematically by the firm about fifteen years ago, when the work was first advertised as for the trade. However, it has not been developed lately to any extent, the energies of the firm being more freely spent on lathes. The wheel-cutting machines put down number 36, and include Brown & Sharpe, Gould & Eberhardt and Gleason machines. In addition, there are a few made by the firm itself, as, for instance, special machines for worm-wheels.

Behind the gear-cutting department is the show-room, at the side of which are workmen's offices, while further over are the smithy, store for paint, boiler-house and so on. The tool-room is at the side of the gear-cutting department, the main passage intervening. This room is a complete machine shop in itself, in which all repairs are done, no work of this kind being undertaken in the various shops. In this room jigs, cutters and tools of all kinds are prepared. The department works on time rates. Below it are the horizontal boring machines, milling machines and drilling machines. Fig. 13 illustrates generally the boring department, 11 horizontal machines being in constant use. This section is perhaps better shown in Fig. 14, where the machine at the right hand in front illustrates the employment of jigs, a headstock being under treatment. Jigs necessarily form a regular feature throughout the work of this firm.

The last illustration, Fig. 15, shows the testing department. Here all the machines are examined before being sent away, and the illustration shows the various kinds of lathes made by the firm. The lathe on the right hand is of the ordinary cone double-geared type; then come two sliding lathes with the firm's variable speed drive; the fourth machine is a 48-inch swing surfacing and boring lathe, also with a variable speed drive; while the fifth lathe under test is a high-speed treble-geared lathe, with a cone pulley on the side shaft. Each lathe manufactured is the subject of an inspector's report, which, besides referring to the order and the number of parts, counter gearing, extras and so on to be supplied, also contains a list of tests to be made on the machine. This list, when filled in, shows not only the error in the part as disclosed by the test, but also the limit allowed. As an example, a table, as issued before the test, is added. This applies to an ordinary 8-inch lathe for screw cutting and self-acting sliding and surfacing with the firm's hand-feed motion. The Blythewood comparator is used for testing spindles.

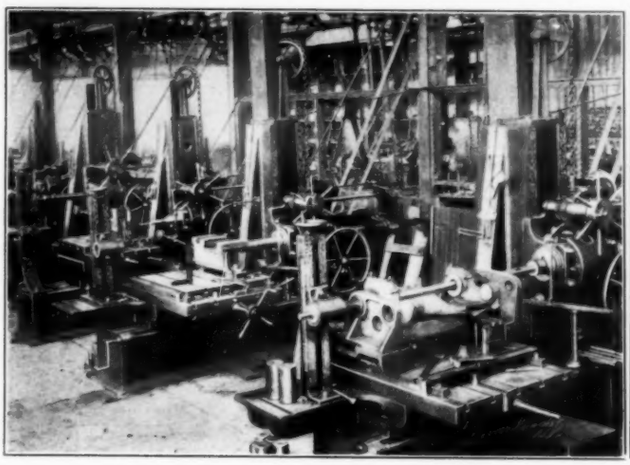


FIG. 14. BORING DEPARTMENT.

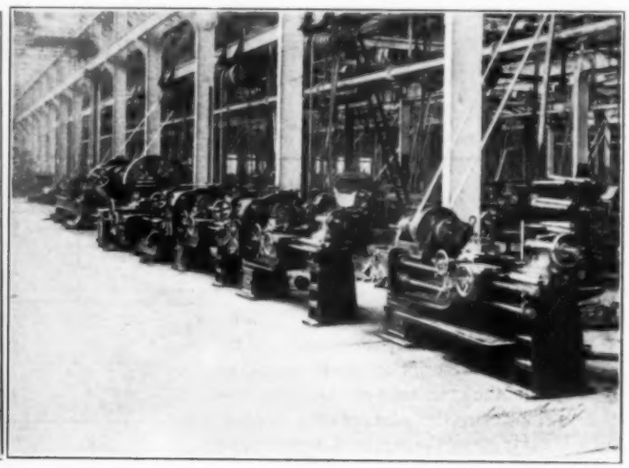


FIG. 15. TESTING DEPARTMENT.

		Limit Allowed
1	Saddle Square to bed	Error 0
2	Shifting Head Spindle parallel with side of bed	Error 0
3	Shifting Head Spindle parallel with surface of bed	Error 0
4	Fast Head Spindle parallel with side of bed	Error 0
5	Fast Head Spindle parallel with surface of bed	Error $\frac{1}{1000}$
6	Spindle Center to run true	Error $\frac{1}{1000}$
7	Both Centers same height, shifting head low	Error $\frac{5}{1000}$
8	Both Centers parallel with side of bed	Error 0
9	Test Cone for running true	Error $\frac{1}{1000}$
10	Spindle to be tested in Grinding Machine	Error $\frac{1}{10000}$
11	Test Face Plate for running true Error	Side $\frac{1}{1000}$ Face $\frac{1}{1000}$
12	Test Chuck for running true Error	Side $\frac{1}{1000}$ Face $\frac{1}{1000}$

LIMITS OF ERROR PERMITTED IN LANG LATHES.

There was an important engineering case on in court. The young attorney had been studying up practical steam engineering overnight, and entered the court room in the morning, bursting with information and clever catch questions with which he intended to floor the expert engineer for the opposition.

The expert took his position on the witness stand and answered question after question fired at him by the attorney for the side upon which he was called. A smug smile of coming triumph overspread the features of the young attorney for the opposition, as the expert was turned over to him for examination. The young attorney cleared his throat:

"Mr. Wilson I understand you call yourself an expert engineer"—this in a voice of withering sarcasm. "What would be the effect, if on raising steam in the ash winch the reversing gear were thrown over and steam were admitted to the low-pressure boiler first, instead of to the condenser, as is usually the case?"

"I cannot tell what the effect would be."

"So you, an expert, cannot answer a simple question like that?"—this with a sneer that brought a titter from the spectators. "And why can't you tell me what the effect would be?"

"Because you ask me a question as sensible as this: "How far is it from the City Hall to Christmas?'"

The utility of a road roller for unusual purposes is shown by some recent occurrences. A small cold-storage plant on Cape Cod had an accident which put both boilers out of commission. In order not to shut down entirely, a couple of road rollers were brought from some State highway work a few miles away and furnished steam until other boilers could be set up. In another case in a New Jersey city, an electric railway persisted in building a bridge without legal authority to do so. Accordingly the city authorities attached their heaviest roller to the girders of the structure with strong chains and pulled them down. When this work was finished the abutments were destroyed.

Cement for Iron.

Equal parts red lead and glycerin (about putty consistency). Make fresh, quick.

Studies in Inventive Problems—XI.

Proposed by Leicester Allen and Solved by Various Readers.

We are now to consider solutions of Problems IV and V, and I think I can present in the present article the majority of the solutions of Problem IV so far received, and also to announce problems I have scheduled as Nos. VI and VII. But I repeat that if anyone finds other valid ways of solving any of the problems already proposed, it will be perfectly in order to send them in. Two solutions of Problem III first claim attention.

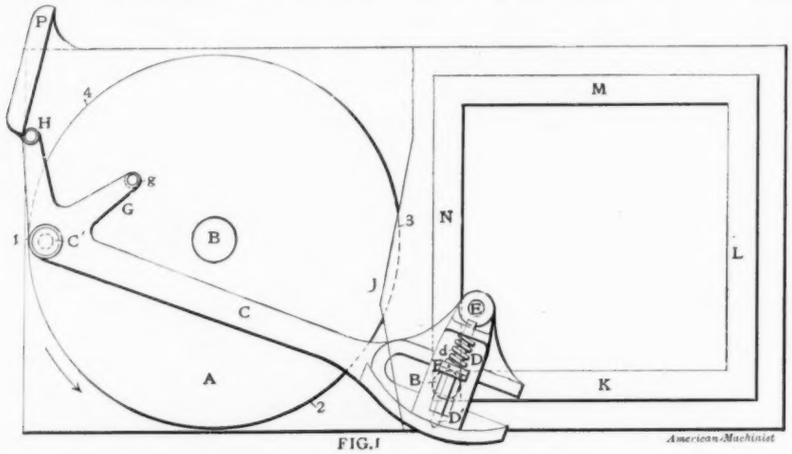


FIG. 1

STUDIES IN INVENTIVE PROBLEMS—XI.

PROBLEM III, SOLUTION NO. 13, FIG. 1. H. POLLARD, PAISLEY, SCOTLAND.

Mr. Pollard's description does not clearly explain the method of holding the sliding block in the slot of the hinged arm *D*. He says the squared upper portion of the block is fitted in the slot. If the squared upper portion be part of the block, or if rigidly attached to the block, it appears to me that his solution may fail. But as I wish to avoid doing anyone an injustice, I present his sketch and his description, which follows:

"The crank disk *A* is made to rotate continuously by the shaft *B* in the direction indicated. The pitman *C* has an arm *D* hinged to it at *E*. Along *D* is cut a slot in which fits the squared upper portion of the sliding block *B*.

"The arm *D* can be locked by means of the pointed spindle *D'*, pressure being supplied to hold it in its countersink by means of a helical spring *d*, the tension of which can be increased by screwing up the two nuts at *F*. If the disk rotates from 1 to 2 the sliding block is carried to the end of branch *K* of the rectangular path, the pressure exerted by the spring being sufficient to overcome any resistance the sliding block has to meet, and thus the arm *D* is kept locked throughout the stroke. When the end of the path is reached the arm *D* cannot move forward, but the pitman continuing to do so compresses the spring and forces *D'* out of its countersink. At this stage the arm *G*, integral with *C*, and carrying on its end a roller *g*, comes in contact with the wedge portion *J* of the guide, which arrests the forward movement of the pitman *C*, causing it to rock on its pin *C'*. The arm *D* being free to move, it overcomes the arc until the stroke is completed by the disk revolving from 2 to 3, when it is again locked by *D'*. The disk, revolving from 3 to 4, moves the sliding block to the end of branch *M*, when the same series of operations as before takes place. The disk moving from 4 to 1 releases the arm *D*. The arm *H*, fast to *C*, in contact with *P*, which is fast to the table, and the pitman *C* rocking on *C'*, brings back the sliding block to its original position, where, after again being locked, it is ready to start again around the stipulated path. The crank, by making two revolutions per minute, moves the sliding block at the required rate—four feet per minute—along the top and bottom branches of the path, and, by making the arms *G* and *H* longer or shorter, the required rate can be obtained along the branches *M* and *K*."

If the squared upper portion of the block is rigidly attached to the block, I think the block would have a tendency to twist and bind in the branch *K*, as the angular relation of *C* and *D* evidently cannot be constant in passing over this branch of the path.

PROBLEM III, SOLUTION NO. 14, FIGS. 2, 2-a, 2-b AND 2-c. HAROLD SMITH, BRADFORD, ENGLAND.

"A circular plate with a slot in it drives the square block *D*. The part *B* and guides *C* have lips, as shown in Fig.

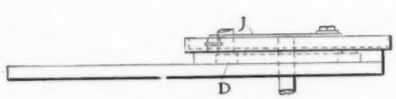


FIG. 2

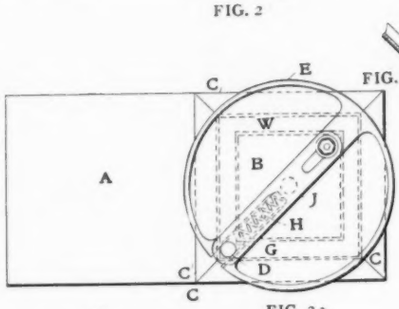


FIG. 2a

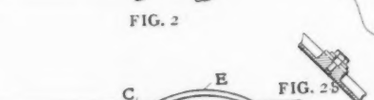
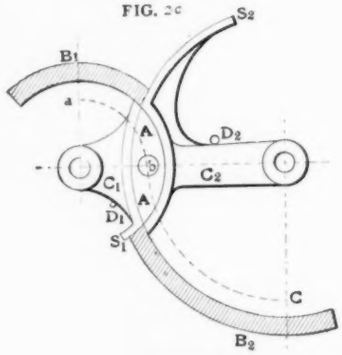


FIG. 2b

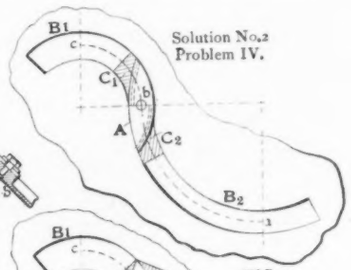
FIG. 2c

Solution No. 4
Problem III



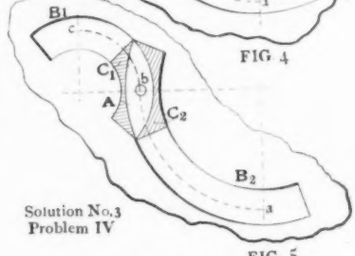
Solution No. 1
Problem IV

FIG. 3



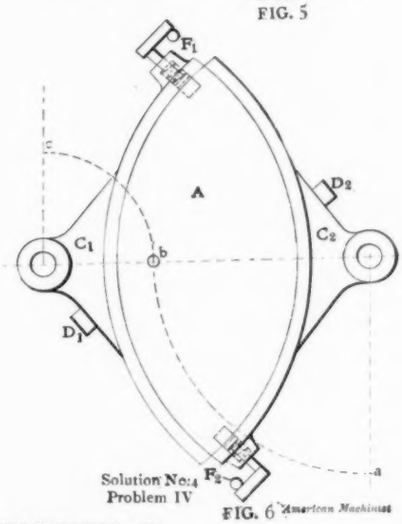
Solution No. 2
Problem IV.

FIG. 4



Solution No. 3
Problem IV

FIG. 5



Solution No. 4
Problem IV

FIG. 6

American Machinist

STUDIES IN INVENTIVE PROBLEMS—XI.

2, to prevent the block *D* from rising in the way *W*. The square block has a round part projecting vertically as much as necessary and just small enough to slide between the lips of *B* and *C*. A saddle *G*, working in the slot of the circular plate *E*, is pressed against the round part of block *D* by a compression spring *H*. The saddle *G* has a tongue on each side of the slot in the circular plate. A cap *J* fits over the slot and is fixed to the saddle *G*, moving with it. The shoulder screw through the slot in *J* serves to steady the cap, but allows it to slide with the saddle *G*. The cap also keeps the compression spring in place. Fig. 2-b is a section through the circular plate, cap and shoulder screw. Fig. 2-c is a section across the slot, cap and spring. A shaft, fast to the circular plate *E* in the center, passes through *B* and is driven below the table by spur or bevel gearing. The spring will always keep the block pressed against the outer guides and prevent it from tilting at the corners. The circular plate and cap will protect the ways *W* from chips and dirt. The speed of the block will vary a little, being greatest at the corners; but, considering the slow speed and the class of work it is used for, this will not be detrimental. Cap *J* would project beyond the edge of plate *E*, so that when drawn in to its full extent it would still cover the slot. To avoid confusion, the center lines and dotted part of the slot are omitted in Fig. 2."

The feature of covering the ways *W* by a circular plate in this solution is excellent. I cannot say so much of the means employed for holding the block square while turning the corners of the path. If the progress of the block should be opposed by any considerable and unequal resistance, the spring would need to be strong and would generate unnecessary friction.

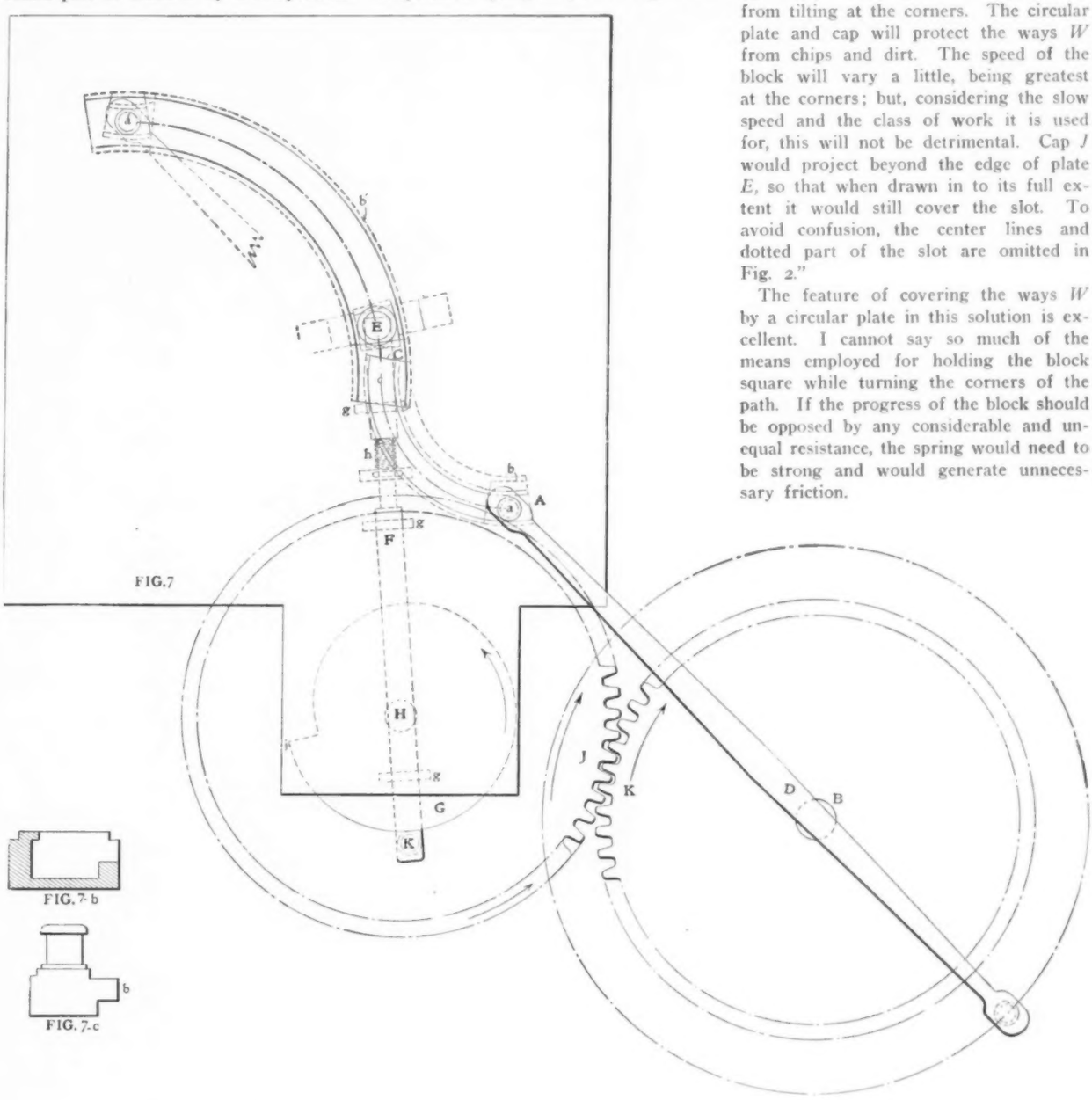


FIG. 7

FIG. 7-b

FIG. 7-c

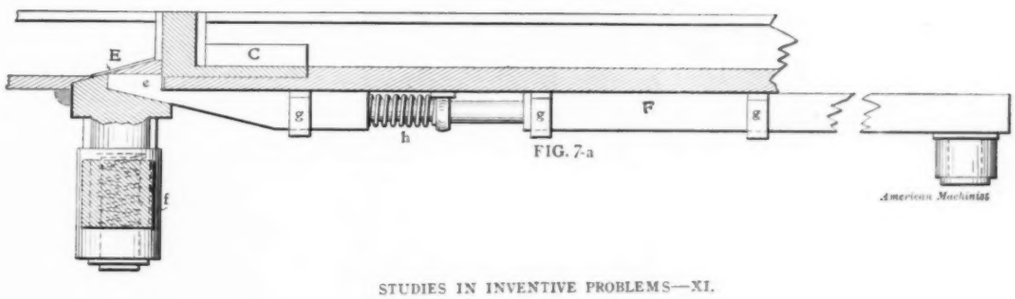


FIG. 7-a

American Machinist

STUDIES IN INVENTIVE PROBLEMS—XI.

PROBLEM IV.

The first solutions of Problem IV that came to hand were from Carl Ulmann, of New York city, who has shown much interest in this series of articles, and a remarkable facility in working out solutions to the problems presented. In fact, some of the best solutions have been those contributed by him. In introducing his solutions of Problem IV, he makes some pertinent criticisms, which I am glad to receive, because, as I intimated in the previous article of the series, I think there has been a lack of criticisms that would, if offered, heighten the interest and value of these studies. Mr. Ulmann writes:

"It is not clear to me why the terms '*cyma recta*' and '*cyma reversa*' should have been introduced. While they apply in architecture and mean distinctly different things—for instance, referring to the shape of a coping—I should think that in mechanism they are really indentical, the one being transformed into the other by turning the mechanism around."

To this criticism I reply that, in stating the problem, my mind was running on the uses to which the various slide movements which have developed by a sort of evolution from the one shown in Problem I might be put in the production of graceful and ornamental forms used in architecture and in decorative arts. The carving of tracery in *bas relief* is now done on what are called "carving machines." The terms used in describing the curve were fresh in my thoughts, and so, as a straw may give direction to a current, particularly if the current be a small one, I suppose I was at the time oblivious to any other name by which the curve can be identified. I might have called it an "*ogee*," but that is an architectural term also, and I should not have bettered the description. I think I made it clear that whether called "*cyma recta*"

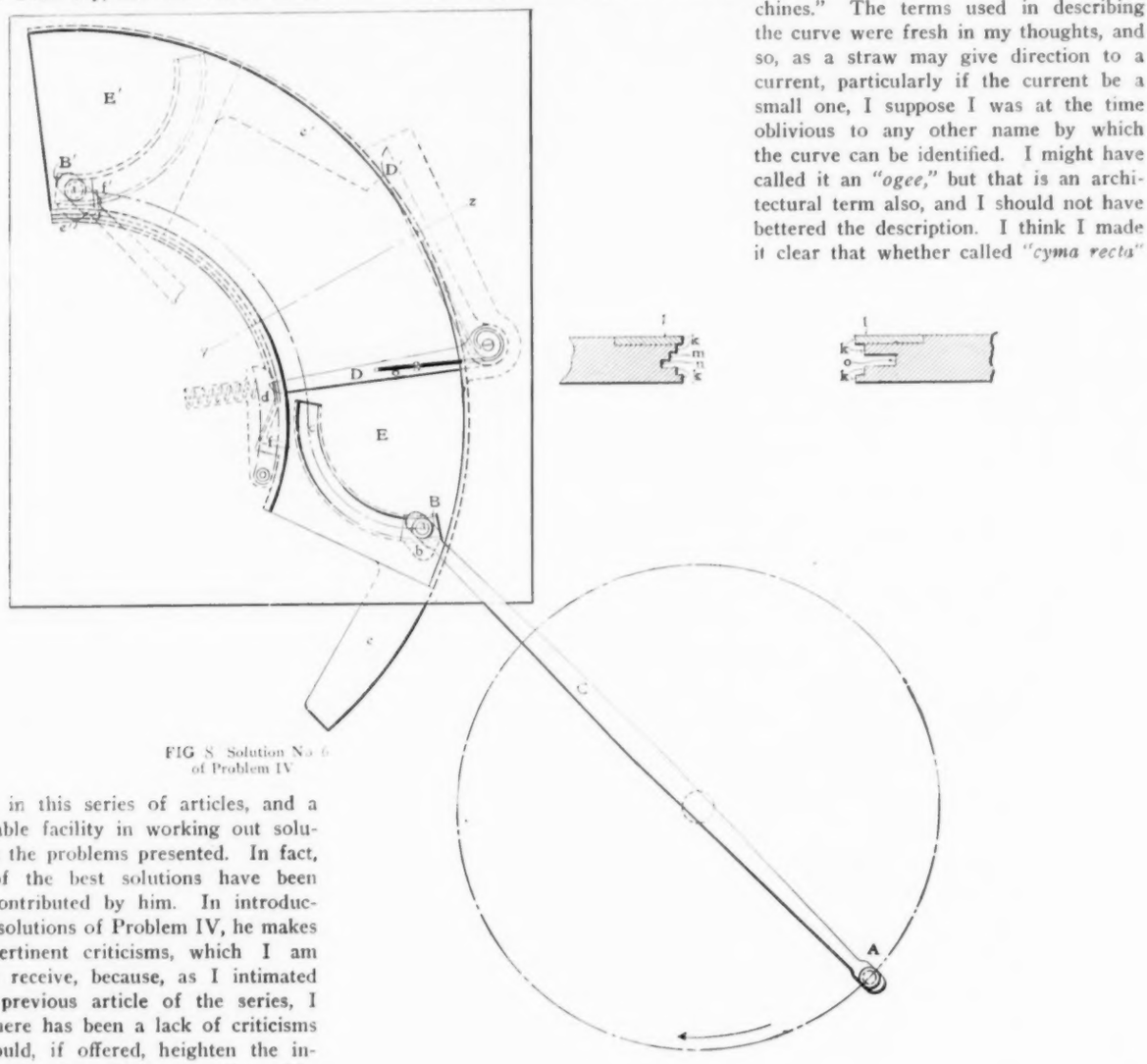


FIG. 8. Solution No. 6 of Problem IV

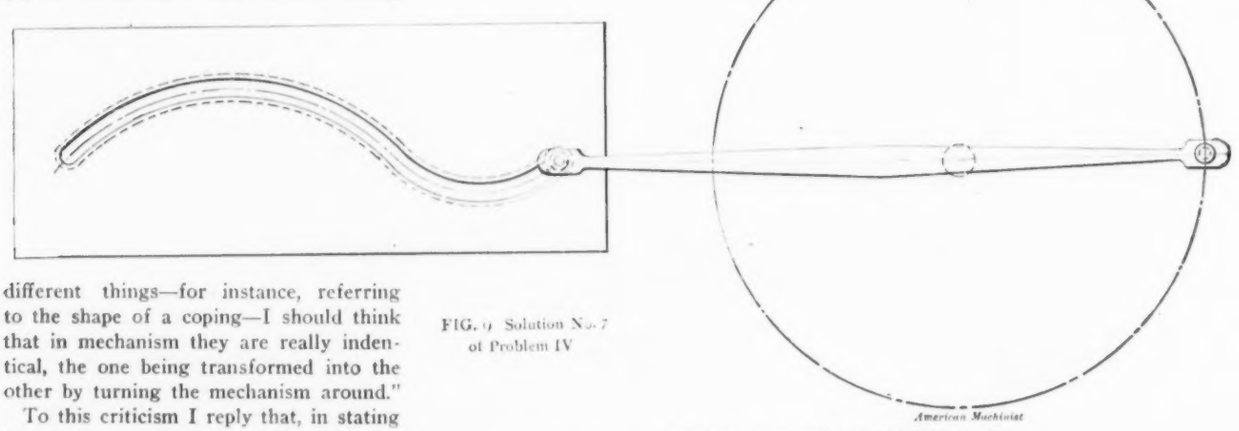


FIG. 9. Solution No. 7 of Problem IV

or *"cyma reversa,"* the curve meant one and the same thing; and as Mr. Ulmann so understood it, and has worked out his excellent solutions on that basis, I still think that, perhaps clumsily, I succeeded in making myself understood.

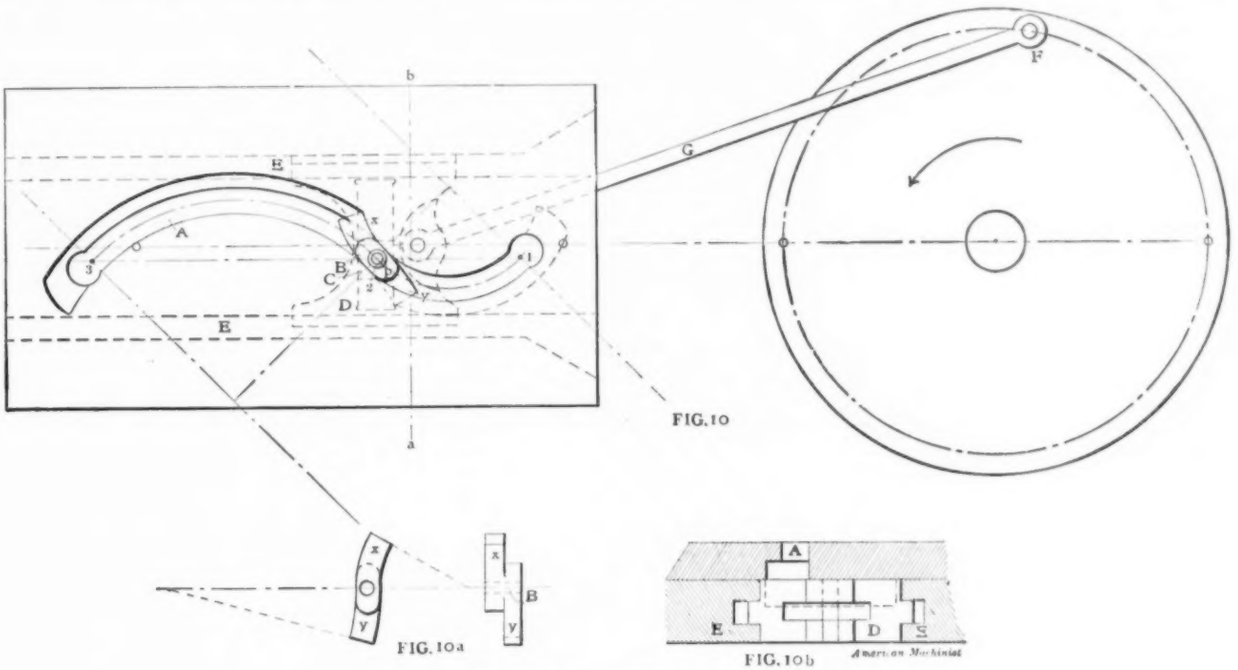
Mr. Ulmann further writes:

"Problem IV is one which would not easily occur in practice, because the designer would naturally resort to cam grooves in the shape of the desired curve, in which a cam roller would perform the prescribed movements. I presume, however, that the problem has been posed for educational objects only, and have accordingly solved the same."

To this I reply that all the problems have been posed with an educational object only, though I have indulged in some hints of possible applications. Some of them have been derived from my own practice in designing, and Problem IV happens to be one of these. I could show, if it were worth while, that to move a certain rock lever in relation with the rotation of a shaft at some distance therefrom, this rock lever being accessible by no other route, except a space (let us call it "ogee" this time) between spur gears, I had to use precisely the device which he shows in his second solution of the problem in question, and, the resistance being very light, it worked well for the purpose. My own experience has been that in designing machines for special purposes, demanding peculiar movements and combinations such as enter into calculating machines, printing machines for special kinds of printing, etc., pre-existing mechanical constructions to which the designer would *naturally* resort, are, nine times in ten, things which, owing to new limitations, will not perform the function desired. Mr. Ulmann also writes:

"If it is objected that the solution Fig. 3 does not contain shuttle blocks, this can be refuted by showing the successive stages by which it was arrived at, each one of which in itself may be taken to represent another solution of the problem. I rather fear that Mr. Allen will be troubled with more solutions than he seems to expect, because the explanations on page 162 of his last article lead very plainly up to this."

My comment upon this is that I found, not only in this series of problems, but in the analogous series published years ago in AMERICAN MACHINIST, that failure to catch on to such "lead-ups"—if I may coin a word—was one of the weaknesses brought into view in the progress of the series. The power to quickly seize a logical mechanical sequence which Mr. Ulmann evinces, is, I think, one of the rarest qualities of the average draftsman and designer. I am glad to have held this little debate with Mr. Ulmann, who, though I have not the pleasure of his personal acquaintance, has convinced me that he is an intelligent gentleman possessing high-grade mechanical talents.



SOLUTION NO. 8 OF PROBLEM IV.

PROBLEM IV, SOLUTION NO. 1. CARL J. ULMANN, NEW YORK CITY.

Mr. Ulmann's first solution, Fig. 3, consists of two guides B_1 and B_2, two oscillating arms C_1 and C_2, carrying spur arcs S_1 and S_2, and the stops D_1 and D_2, each limiting the oscillations in one direction. A is the block carrying the spindle b. The right-hand margin of the block has the same curvature as that of guide B_1, while its left-hand margin has the same curvature as that of guide B_2. Alternate oscillations of C_1 or C_2, each through an arc of 90°, will move the block A successively over the branches $a\,b$ and $b\,c$ of the path, as demanded by the conditions of the problem.

PROBLEM IV, SOLUTION NO. 2, FIG. 4. CARL J. ULMANN, NEW YORK CITY.

"Fig. 4 shows an arrangement which comes nearest to the shuttle blocks illustrated by Mr. Allen. The dotted lines in block A are supposed to represent T-slots, which project from the shuttle blocks C_1 and C_2 into block A. In Fig. 5 these T-slots are done away with and the shuttle blocks extended so as to surround block A."

PROBLEM IV, SOLUTION NO. 3, FIG. 5. CARL J. ULMANN, NEW YORK CITY.

"This embodies the identical principle with the difference that the inner flank of the guideways has been moved in toward the centers of the respective circles, so that the shuttle blocks C_1 and C_2 themselves take the place of these inner flanks. There are also provided stops D_1 and D_2, which prevent the shuttle blocks from moving further than they ought to. The shuttle blocks themselves are continued into spurs S_1 and S_2, each one of which serves the purpose of holding in position the opposite shuttle block, while it is not active. B_1 and B_2 are what remains of the stationary guides."

PROBLEM IV, SOLUTION NO. 4, FIG. 6. CARL J. ULMANN, NEW YORK CITY.

"The same principle has been extended further in a somewhat monstrous looking solution, Fig. 6, in which block A and shuttle blocks C_1 and C_2 are so much enlarged that they altogether take the place of the slides, which, therefore, as separate

parts of the mechanism, are done away with. There are furthermore added locking devices F_1 and F_2, which lock the slide block and shuttle block together, when they should travel together, except in the middle position shown. If the shuttle blocks are provided with T-projections into T-slots in the slide blocks, then this locking device could be done away with."

Now, probably, all this seemed easy to Mr. Ulmann, but his fear that I would "be troubled" with a large number of solutions to Problem IV has not been realized. Doubtless the leading up in previous problems made the study of this one easier; but I do not blush to avow, that when the necessity for such a device as he shows in his Fig. 4 arose in my practice, it took me some days of hard study to reach it, and its solution gave birth to my first idea of a shuttle block, and its use in guiding slides.

It is also to be supposed that ambition to achieve original solutions counts for something in the attempts to solve these problems. The following of a lead has interest, but many prefer to strike out an independent course.

PROBLEM IV, SOLUTION NO. 5, FIG. 7, 7-a, 7-b, 7-c. J. C. MELANCON, AMITE, LA.

"The path of the center of the sliding block A is shown by the lines $a\ c\ a'$. The block A is propelled by a crankshaft B through a connecting rod D. Fig. 7-a shows a cross-section through the auxiliary block, and Fig. 7-b an end view of the main block. At C is shown an auxiliary block which receives the main block at the point c (point where reverse curve begins) and carries it over the remainder of the prescribed path. As a part b of the edge of the main block is turned to the same arc as the outside guide surface b' of the guideway of the larger arc, and bears thereon, there is no tendency of the main block to pull out of the auxiliary block on the return stroke. The mechanism by which the auxiliary block is held in place to receive the main block and then released at the proper time, is shown in dotted lines in the plan view and also in part elevation and part section in Fig. 7-c. Same reference letters apply to both views. E is a spring gib held in position in the guideway against the end of the auxiliary block C by a weak compression spring f. A sliding bar F, which is guided in its straight "backward and forward" movement by strap guides g is held in the position shown, against the tension of spring h throughout the greater part of the stroke, by a disk cam G on shaft H, which receives its motion from shaft B through a pair of supr gears J and K, which have an equal number of teeth. Cam G is keyed to its shaft in such a position that its point j reaches the roller k at the moment that the geometrical center of the main sliding block A reaches the point c. The sliding bar F is now pulled inward by the strong spring h, its end projecting into the beveled slot e in gib block E, pulling it down and leaving the guideway clear for the sliding blocks to continue their travel. The top of spring gib E is beveled so as to be forced down by the advancing block on the return stroke. Arrows show the direction of rotation."

SOLUTION NO. 6, FIG. 8. J. C. MELANCON, AMITE, LA.

"In this solution the geometrical center of the main block describes the arc of lesser radius entirely within the auxiliary

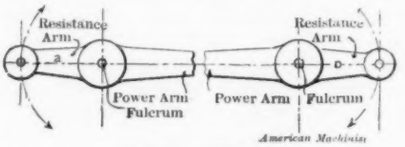


FIG. 11. PROBLEM VI.

block which contains guideways cut for the purpose. The prescribed path is indicated by the dot-and-dash line $a\ c\ a'$, which is to be described by the geometrical center of main block B, whose motion is imparted to it by crank-pin A (which may revolve in either direction) through connecting-rod C. Let us suppose the crank to be turning in the direction of the arrow. When the center of the block arrives at the point c, the boss b on the block raises the catch d, thus releasing the stop D and clearing the way for the auxiliary block E (which carries the main block), to continue its travel in the larger guideway represented by a larger arc. At a' are shown the blocks at the upper extremity of their travel. Arm e on the auxiliary block E is for the purpose of preventing stop D' from returning to its first position D in front of the blocks, thus blocking the guideway against their return. On the return stroke the main block B is kept stationary with respect to the auxiliary block by a spring-stop f', which is kept pressed down by the side of the guideway during the entire length of travel over the large arc of the path. As soon as the upper end of the auxiliary block passes the end of stop D' on the return stroke, the latter, being impelled by the coiled spring g, follows behind until the block arrives at its lower position, when D again engages with the catch d. At this point, that is, when the geometrical center of the main block has reached the point c, there is a recess in the side of the guide which allows the spring-stop f to rise, liberating the main block, which continues its course to a, thus completing the circuit. In the detail section is shown a cross-sectional view of guideway, the section being on line $y\ z$, Fig. 8. Here l and l show the removable tops of the guides; $k\ k\ k\ k$ the inner surfaces of the guides against which the block bears; m, the surface which holds the spring-top f down in front of the main block during the travel of the auxiliary block; n is the recess for passage of the boss b on the main block, and o shows the recess for reception of the stop D when forced up by the auxiliary block."

SOLUTION NO. 7, FIG. 9. J. C. MELANCON, AMITE, LA.

"In this solution the sliding block is a solid cylindrical body which traverses the entire length of the prescribed path without the aid of an auxiliary or 'shuttle' block. To compensate for the small bearing surfaces of block on the guides, it might be made rather long and the guides

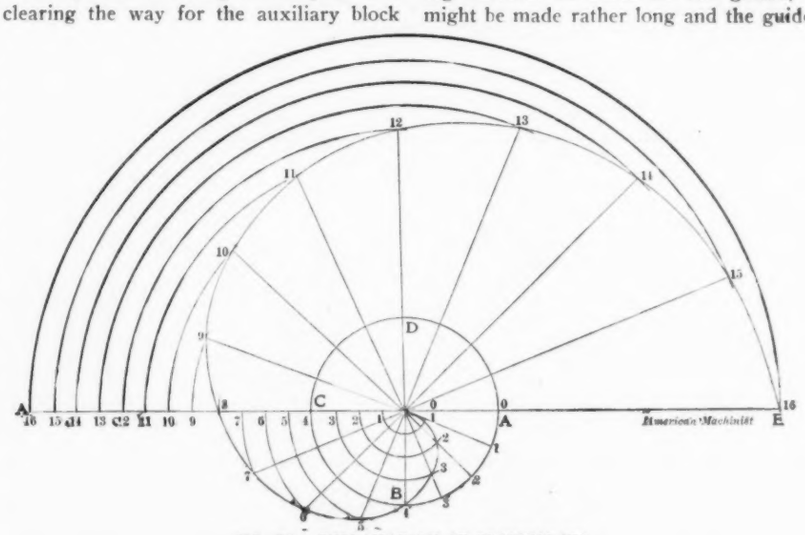


FIG. 12. EXPLANATORY OF PROBLEM VII.

of equal length and of hardened steel. The movement is obvious."

Passing solutions 5 and 6 without further remark than that they possess the advantage of imposing comparatively light friction and wear upon the sliding block and its guides, it seems proper to say of solution No. 7 that while at first it will operate in accordance with the conditions prescribed, very slight wear will permit the rocking of the sliding block on its pivot, causing the central axis of the spindle to move in a staggering path, instead of describing a smooth, continuous curve. I hardly think Mr. Melancon would regard this as the best solution.

PROBLEM IV, SOLUTION NO. 8, FIGS. 10, 10a AND 10b. WILLIAM WHALEY, LA FOLLETTE, TENN.

"Fig. 10 is a plan of the mechanism, Fig. 10a shows two views of the sliding block, Fig. 10b is a section on line *a b* in Fig. 10. *A* is the guideway for guiding the sliding block *B* along the prescribed path of motion. *C* is a rectangular sliding block, with face to move in a cross-slide way formed in the crosshead *D*, and carrying a vertical pin *p* to which *B* is pivoted. *D* is a crosshead moving in guideways *E E* and connected to the crank-pin *F* by the rod *G*. Block *B* is formed with prescribed reverse curves, one being in a plane above the other, as shown in Fig. 10a, the part *X* traveling in the upper part of guide *A* and guiding *B* from point 1 to 2. The part *y* comes into its guides (the lower portion of *A*) at 2, and is the guiding portion of *B* for the remainder of travel. The inner side of each curve on guide *A* is extended beyond the point of the reverse curve 2 a distance equal to the lengths of parts *y* and *x* of the slide *B*. This prevents the block from tilting at 2. The pitman is shown in a horizontal plane, but, if desired, could as well be placed in a vertical plane. The crosshead *D* is operated reciprocally by crank and rod *G*, the block *B*, pivoted to cross-slide block *C*, is moved along curved guides *A*, the block *C* sliding in its guide in *D*.

As the present article is approaching its limit, I will here present:

PROBLEM VI. FIG. 11.

Two rock levers, *a* and *b*, of equal length, having their separate fulcrums or bearings, located on one and the same straight line and in the same plane, are to be simultaneously moved through equal arcs to and fro continuously, *against variable resistance*—that is to say, *both levers are to be moved by one and the same drive—the single crank and pitman.* The force of this drive must be so applied, disregarding friction, *that, at any point of the simultaneous movement, each lever shall receive a part of the total driving force, exactly proportional to the resistance it is overcoming at that point.* The arcs of oscillation will be more than 30 degrees.

The following mechanical elements are barred from use in the solutions: 1. Spur gears, bevel gears and friction pulleys, except in the drive of the crank-shaft. 2. Racks, either circular or straight. 3. Flexible connectors, either on sprockets or pulleys. 4. Links, other than the single pitman, which, being a bar pivoted at each end, is, strictly speaking, a link. 5. Cams. 6. Crown wheels, or trundle wheels. The solution must be susceptible of a good, strong construction.

PROBLEM VII. FIG. 12.

Referring to Fig. 12, if on a line *A E* and from center *o*, on this line we set off any distance *O A* as radius, divide this radius into any number of equal parts, say, for our present purpose, 16, then draw a circle with *O* as center and with any convenient radius, say, *O C*, then divide this circle by radial lines into the same number of parts as that into which we have divided the radius *O A*, extending the radial lines beyond the circle *O D C B* when necessary, then with center still at *O* draw arcs of circles with radii *O*-1, *O*-2, *O*-3, etc., arc 1 cutting radius *O*-1, arc 2 cutting radius *O*-2, arc 3 cutting radius *O*-3, and so on for all the arcs and radii, then join successively the center *O* and points of intersection of the radii 1, 2, 3, etc., by curves, each of which is tangent at its extremities to the one preceding and following it, we have the so-called spiral of Archimedes, who was the most famous of ancient methematicians, mechanicians and inventors. Nature, however, was before him. She used the curve for constructing snails' houses, and in building ships for that primeval yachtsman, the nautilus, the first living being that utilized the force of wind for sailing over the surface of the sea. The curve is much used in Arabesque tracery in wood-carving and in other decorative arts and is one of the most beautiful known to geometers. By inspecting the figure it will be seen that a point moving at constant velocity from the center outward, on a radius which swings about the center at a constant angular velocity, describes the spiral. As either the velocity of the point, or the angular velocity with which the radius revolves about the center, may vary, each independently of the other, for different spirals an indefinite number of these spirals may be produced; *but for the purpose of this problem we will limit it to the one shown in the figure, in which O A (the radius vector, as mathematicians call it) is divided into sixteen parts while the circle A B C D is also divided into sixteen parts, the radius vector sweeping over these parts at such an angular velocity, that being supposed to be turned into the position O E it will turn clockwise about O, at a constant angular velocity and reach the position O E again during the same time that a point describing the curve moves (at constant velocity) over the radius vector O A.*

Now we will suppose that, say, a manufacturer of cabinet house trim wishes to obtain a carving machine, to cut such a spiral in *bas relief* in many thousand pieces of wood work, and that he does not want to work by a pattern, but desires a cutter spindle to do the work without a pattern.

The problem will then be *to cause the axis of a vertical cutter spindle, carried by a slide,* and operating upon stock *held on a horizontal table, to follow such a spiral path. The solution must also supply a drive* for both the slide and the cutter carried by the spindle.

I hope no one will be deterred from attacking this problem on account of the little taste of mathematics it contains. The difficulty in solving it will be more in working out the drive than anything else. But in solving it, *cams are excluded.*

Shot Iron.*

BY THE FOOS MFG. CO., SPRINGFIELD, O.

We use one of the large-sized Sly Cinder Mills to remove the shot iron from the cupola slag, and find it a paying investment. Our method of operation is about as follows:

During all seasons save when the weather is extremely cold we reclaim the iron daily, but during the months of January and February we have been in the habit of putting the machine out of commission, allowing the slag to accumulate, and then as soon as the weather will permit, we begin operations and within a few weeks have the accumulation out of the way. During this period we usually reclaim more iron than we are able to melt each day, as at this season of the year our foundry heats are rather small. There is a period, therefore, during several weeks when the amount of iron reclaimed is somewhat in excess of the amount melted, but as we always protect the excess from weather conditions, the corrosion is not very marked where it is not to remain unused for a considerable length of time. We believe it is very much better to remelt this shot daily, and under these conditions there is no possibility of its giving any trouble in the cupola. Our method of handling it is as follows: We do not make any charge of the shot on the first four heats, nor on the last two heats, but on each of the changes between. Our charges are made up as follows: 700 pounds of iron and 300 pounds of shot, and this would continue throughout the heat except as stated above. There have been times when we have used a greater proportion of the shot, but we find this combination to work very satisfactorily in our cupola and on our work. A fair proportion of our work is gas engine, exploder boxes, etc., and we think you will agree with us that this class of castings are about as exacting in their requirements as any that are ordinarily made.

We recover our coke and allow it to accumulate until fall, when we run it over a pneumatic separator which we have built for our own use, thus separating out all slag and other foreign material. Last winter we disposed of perhaps 50 tons to our employees, who used it in furnaces in their homes and some in base-burners. From this one can judge of the quality and condition of the coke.

As to any trouble in the material going through the cupola and being discharged

*Discussion before the American Foundrymen's Association.

into the ladle without being re-melted, this will not result except the shot be allowed to remain for a long time after having passed through the machine, when we believe it might be sufficiently corroded to encrust it in the shell which might not melt in passing through the cupola, but when the shot is used daily there is not the slightest danger from this cause.

Consul-General Guenther, of Frankfort, supplies the following railroad statistics: According to the most recent German statistics, the length of the railroads of the world was 537,105 miles on December 31, 1904, of which 270,386 miles were in America, 187,776 miles in Europe, 46,592 miles in Asia, 15,649 miles in Africa, and 16,702 miles in Australasia. Of the mileage of European railroads, Germany stands first (34,016), followed in their order by Russia (33,286), France (28,266), Austria-Hungary (24,261), the United Kingdom (22,592), Italy (10,025), Spain (8,656), Sweden and Norway (7,730). The average cost of construction of the European railroads per mile is estimated at $107,577, while for the remainder of the world the estimate is only $59,680. The total value of the railroads of the world, according to these statistics, is $43,000,000,000, of which the European roads figure for $22,000,000,000. The estimate for rolling stock is as follows, in numbers: Locomotives, 150,000; passenger coaches, 225,000; and freight cars, 3,000,000.

How is that shop-heating system?

The Lo-Swing Lathe.

The accompanying illustrations show a novelty in lathe design, which is the product of the Fitchburg Machine Works. As our readers follow the description and examine the illustrations they will, we think, recognize in the design the fine hand of James Hartness, of the Jones & Lamson Machine Company. Mr. Hartness has, however, no official connection with the Fitchburg company.

OBJECT OF THE MACHINE.

The object of the design is to provide a single purpose lathe for doing work on bar stock of the class that must be done between centers, and nothing else. It will not face, bore, nor do chucking work, and the elimination of the features necessary for these functions leads to some striking results. Discarding the chucking and facing functions eliminates the cross slide and makes possible the reduction of the swing to that necessary to accommodate bar stock, the result being to place the tool extremely close to the carriage slide and to secure the rigidity of tool support and control which that arrangement entails. Other modifications make it possible to secure the leading advantage of the turret lathe, namely the use of several tools, each set for one cut only, and brought into action without the delay due to the use of calipers and the making of trial cuts. The length of work done between centers gives rise to an advantage which the turret lathe does not possess, namely, simultaneous action of several or all of the tools, danger of damage to the work being obviated by independent throw-outs of the feeds of the various tools.

The general appearance of the machine is shown in Fig. 1. It will be seen at once that it has the single belt-speed type of headstock, the various speeds being obtained by gearing within the head. These gears are enclosed and dip in a supply of oil to provide flooded lubrication. In doing work of the class intended changes of speed are infrequent. There is nothing to compare for example with the turning of a flange and drilling a hole in its center, which frequently follow one another in turret lathe work and call for frequent changes of speed. With the work for which this lathe is intended, the diameters on one piece of work do not widely differ, and moreover, the turning of the different diameters is done simultaneously, the result being that, normally, the speed will not be changed from the beginning to the ending of the making of a lot of parts. These considerations make clutch mechanisms and quick change levers unnecessary, and they have been discarded. The drives are positive and a change of them can only be made when the lathe is at rest.

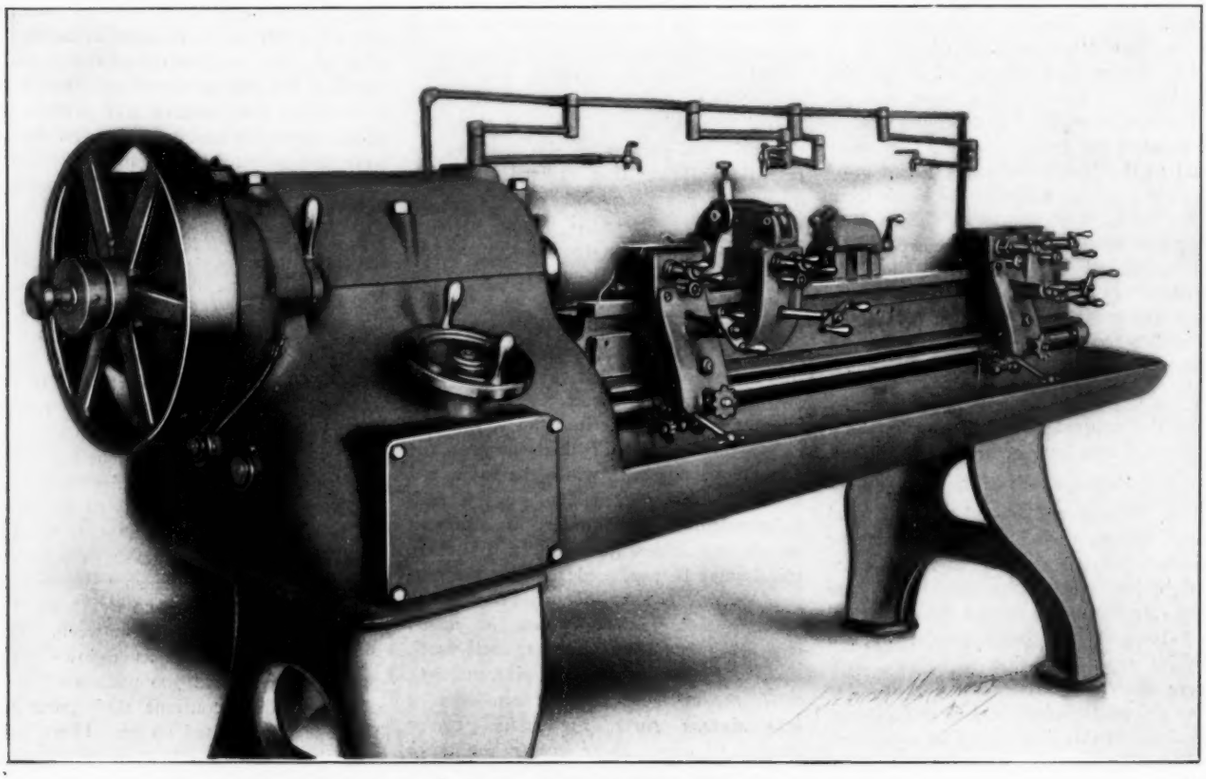


FIG. 1. THE LO-SWING LATHE.

THE HEADSTOCK.

Fig. 2 is a plan section of the head. The piece *a* is keyed to the spindle and has a clutch pin *b* projecting inwardly. A latch bolt *c* may be thrown outwardly by the thumb-piece *d* and be engaged with *b*, thus causing the pulley *e* to drive the spindle directly. The hub of the pulley has a

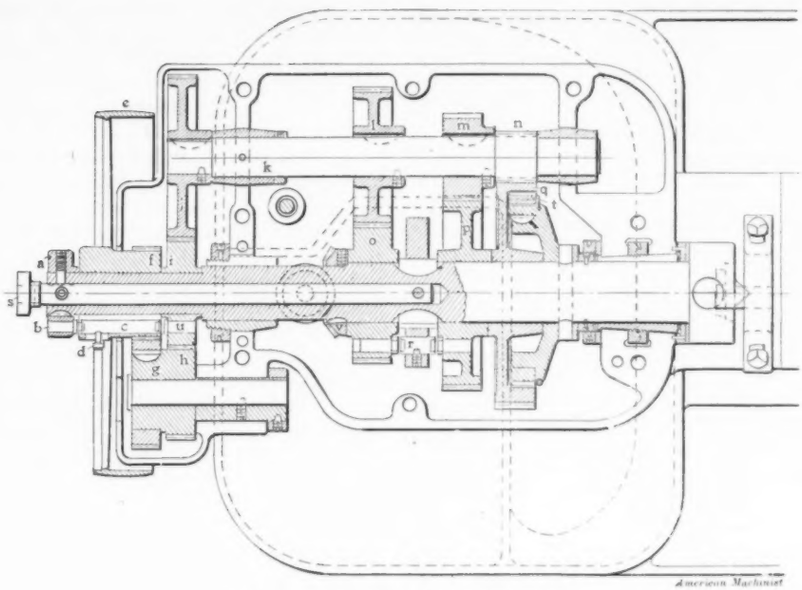


FIG. 2. PLAN SECTION AT HEADSTOCK.

pinion *f* integral with *e*. With the latch bolt *c* in its mid-position and gear *g* engaged with *f* by throwing its eccentric shaft, the drive is from *f* to *g*, to *h*, to *i*, to *j*, to shaft *k*, on which are mounted gears *l*, *m* and *n* meshing with *o p q*, respectively. Gears *o* and *p* are engaged with the spindle by the clutch *r*, which is operated by the pull-pin *s*, while *q*, which gives the slowest motion, drives the spindle by a ratchet and pawl at *t*, this pawl having a friction throw-out which acts in case any faster gear is engaged. With gear *g* disengaged from *f* and latch bolt *c* thrown to the right, it engages with pin *u* and gives another set of speeds. A speed plate attached to the headstock gives the positions of the pins for the various speeds. At *v* is a bevel gear which drives the feed works, which are of the Sellers friction-disk type and adjusted by the inclined graduated disk shown in front of the headstock in Fig. 1. The feed works, like the driving gear, run immersed in oil. Gear *f* also drives a gear, not shown, to which the oil pump is attached, which, being thus driven from the constant-speed belt pulley, runs at the same speed regardless of the speed of the work.

THE TOOL CARRIAGES.

The general appearance of the tool carriages will be gathered from Fig. 1, from which it will also be seen that they may pass the footstock. They are of two types, both of which are shown. The one at the extreme left has an automatic feed, while the next one to it has hand feed only.

The automatic feed carriage is shown in Fig. 3. The first point to attract attention is the method of supporting the tool. The tool *a* has a machined shank fitting the socket *b*, in which it slides for adjustment by the action of the screw *c*, which bears directly on the end of the tool, a notch and yoke connection causing the withdrawal. Two holes are provided in the tool-block, as seen in the right-hand view The holder being placed in either hole,

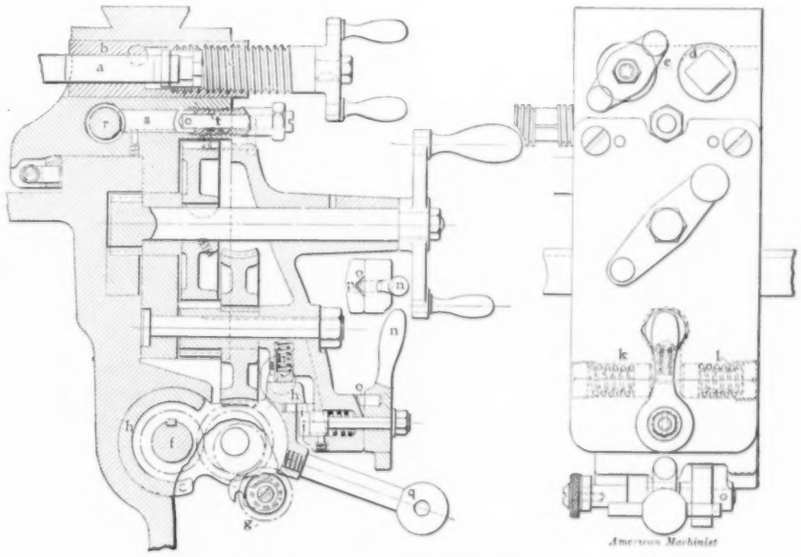


FIG. 3. AUTOMATIC FEED CARRIAGE.

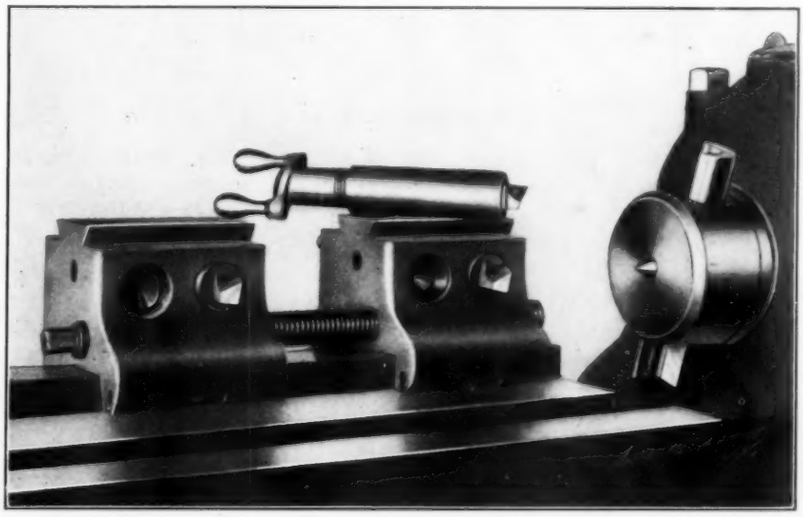


FIG. 4. CARRIAGES, TOOL-HOLDER AND EQUALIZING DRIVER.

an eccentric piece *d* is placed in the other, a connecting piece *e* serving to bind the holder by a slight turn of the eccentric. This construction and the general form of the parts is shown more clearly in Fig. 4.

The feed is by the splined rod *f*, and in order to provide for independent feed of the carriages, tumble gears *g* are provided in the carriages themselves, which may be thus fed in either direction at will. The tumble gear is mounted in a swinging frame *h h*, which is held up by the latch pins *i j* and is free to slide endwise of the rod to a limited extent, but is normally held in a central position relative to the carriage by two springs *k l*. The stop is positive, being a block which may be inserted in the feed rack at any desired point. The carriage abuts against this stop, its motion being thus arrested, but after it is thus stopped the action of the feed gear is to traverse the frame *h h*

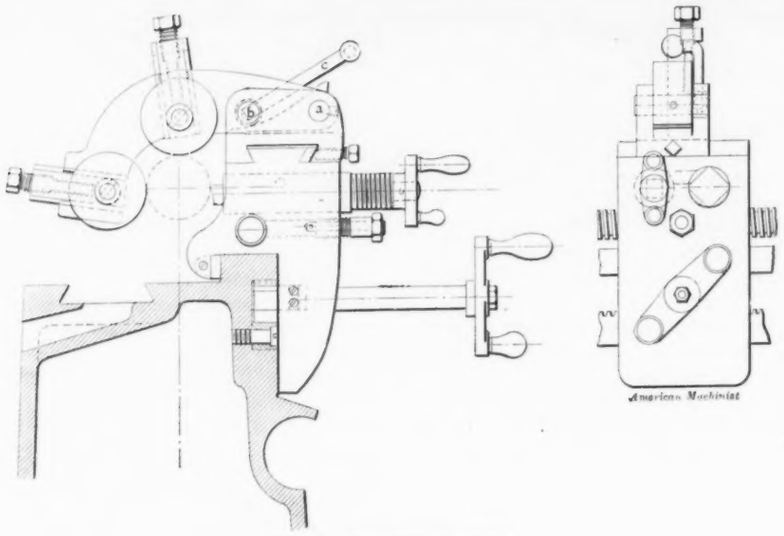


FIG. 5. THE FOLLOW REST.

lengthwise of the feed rod until latch pin *i* passes *j*, when spring *m* throws the frame down and disengages the gear. Handle *n* has a pin *o* lying within a notch *p*, and by turning the handle pin *j* may be withdrawn from *i* and the feed be thus disengaged at pleasure. Handle *q* re-engages it.

As has been said, a portion of the carriages have hand feed only, but a connecting right- and left-hand screw *r*, shown more clearly in Fig. 4, is provided to connect an automatic and a hand-feed carriage and thus cause both to feed together at a fixed distance apart. A pin *s* has a threaded end, and by the screw *t* is made to perform the function of a split nut and engage the carriage with the screw. In adjusting the distance between two carriages the pin *s* is disengaged and the distance is adjusted roughly by the hand feed of the carriage, when the pin is again engaged and the final adjustment is made by turning the screw *r*.

FOLLOW AND CENTER RESTS.

The cuts contemplated on long and slender work require, of course, a complete system of follow and center rests, and these are shown in Figs. 5 and 6. The follow rest Fig. 5 is attached to the top of the carriage, where a short slide provides for lateral adjustment to accommodate the two positions of the tool. The rests are of the roller type and are swiveled at *a*. An eccentric pin *b* and hand lever *c* provide for binding the rest firmly in the operative position and by loosening and then withdrawing the eccentric pin the rest may be turned bodily backward on the pin *a* and thus be quickly gotten out of the way when changing the work, and as quickly replaced for the following piece. It is thus not necessary to disturb the tools when changing work. The center rest, Fig. 6, is similarly arranged for changing work by the swivel *a* and locking pin *b*. Both Figs. 5 and 6 show the tool in its operative position and the extremely close connection between work, tool and lathe bed.

THE FOOTSTOCK.

The footstock is shown in Fig. 7. The main feature of the design is a general form which will permit the passage of the tool carriages past it, as shown in Fig. 1. The location of the locking bolt *a* outside the center will be noted, as will the two binding bolts *b* and *c*. The center has no barrel, and is intended to be used as shown, projecting from the body by the shortest possible distance—a feature which is made feasible by the fact that the carriages may pass the footstock. The screw

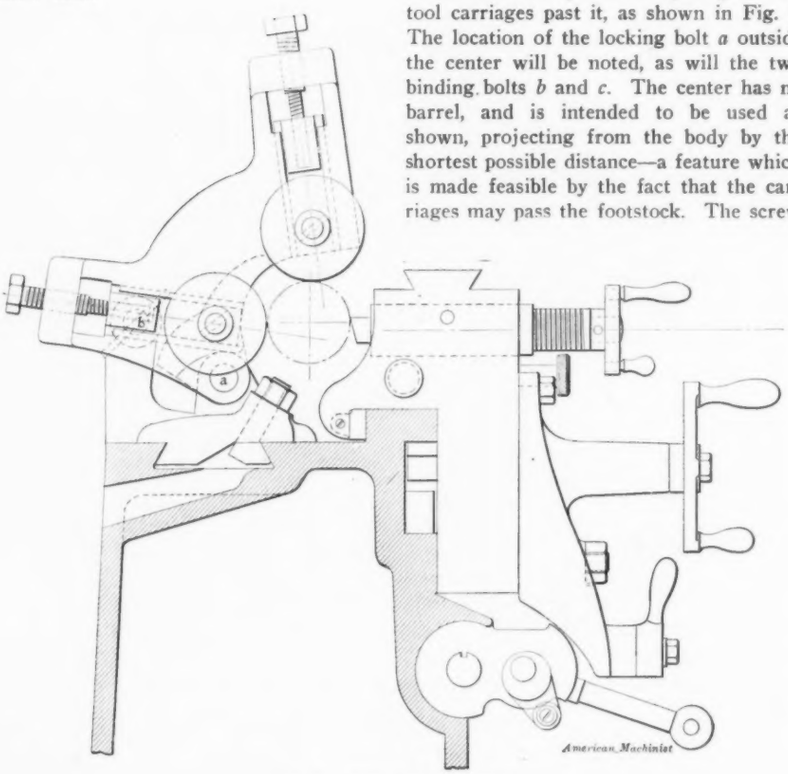


FIG. 6. THE CENTER REST.

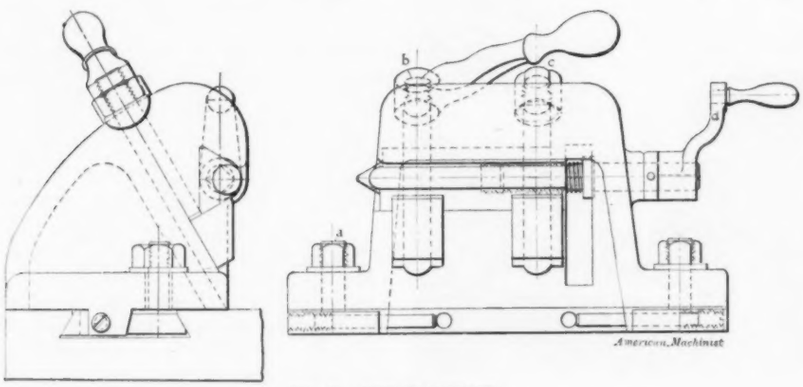


FIG. 7. THE FOOTSTOCK.

end is squared in order that the handle *d* may be removed and replaced in another position in case it interferes with the passage of the tool carriages.

As the lathe is not to do chucking nor boring, there is no need of providing for a face-plate, and the spindle nose and dog take the forms shown in Fig. 8. The dog *a* has four set-screws for gripping the work and two diametrically flatted-off pins *b c* to drive it. These pins bear on the flatted-off edges of the cross-pin *d*, which, being a free fit in the spindle end, gives an equal pressure to the pins *b c* and thus secures an equalized drive. Pin *d* is retained in the spindle by a notch *e*

embracing the end *f* of the disk center *g*, and by turning pin *d* with a wrench applied to its end the center may be removed. The appearance of the spindle nose and balance pin is shown in Fig. 4.

Mr. Hartness is a well-known advocate of the view that the destruction of cutting tools is chiefly due to vibration, and that, with vibration suppressed, not only may much heavier cuts be taken, but that the tools will retain their edges much longer and that they may have keener angles than usual. This belief is, in fact, the mainspring of the design of the lathe, in which firmness of control of tool and work, due to short connections and a reduced number of sliding joints between the two are the leading features. The keenness of cutting-tool angles which it is proposed to use is shown in Fig. 4.

The size of work which the lathe will take in is up to 3½ inches in diameter and 5 feet in length. The legs at the tail-stock end are swiveled to the bed, thus giving a three-point support.

The machine is intended to finish the work done in it, as does any other lathe, but it so happens that the only records of work in lots which are at present available are from a shop in which the finishing is done in grinding machines, and hence the lathe was used for roughing only.

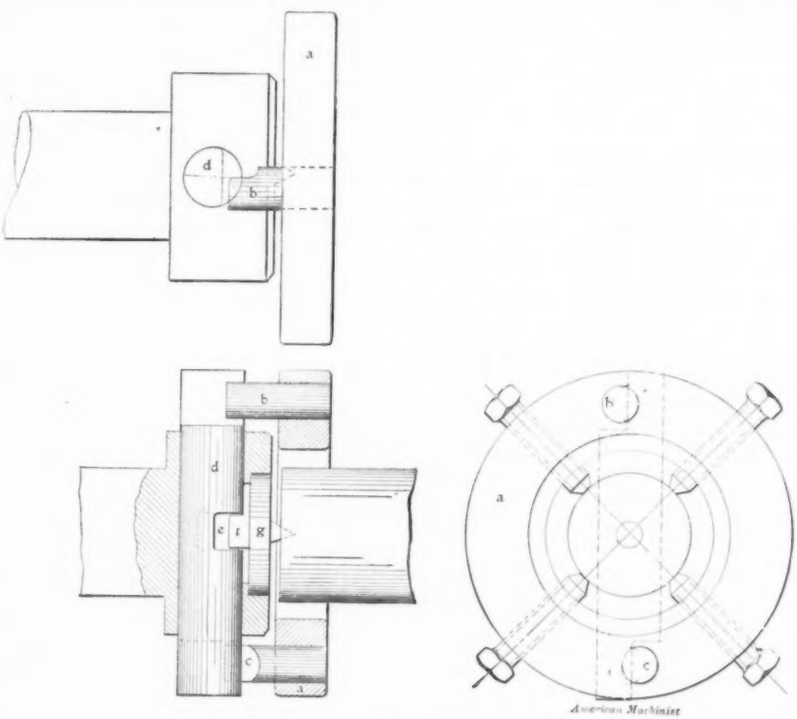


FIG. 8. SPINDLE NOSE AND BALANCED DOG.

Sketches of several of these pieces, with the time consumed per piece, are given in Fig. 9.

Don't stir melting copper too much. Always use sticks of green wood. Avoid sulphur in copper castings—near the cooling point the sulphur separates, but is absorbed again.

Echoes From the Oil Country—Judging by Sample.

After a man becomes interested in something new, and which he thinks may be of use to him in his business, about the next thing he wants is to see a sample of it. So common is this matter of samples that many salesmen carry samples with them and bring up the subject by presenting the sample for inspection, and often for trial, and the action of the sample will go very far in determining the future of the article in that shop.

It is a great convenience to be able to order an article and to say, "We wish this as a sample to test, so that we can decide whether it is suited to our work." The expense is not great to the user, and the manufacturer gets a chance to show what he has. Sometimes a sample is obtained in the open market instead of being gotten directly from the maker, because, as one salesman very truthfully said, "I will guarantee that what we send you will not be a bit better than this sample," and it is often felt that an article picked up at random will more nearly represent the regular output than one sent to be tested.

There is another side of this sample business that is sometimes overlooked.

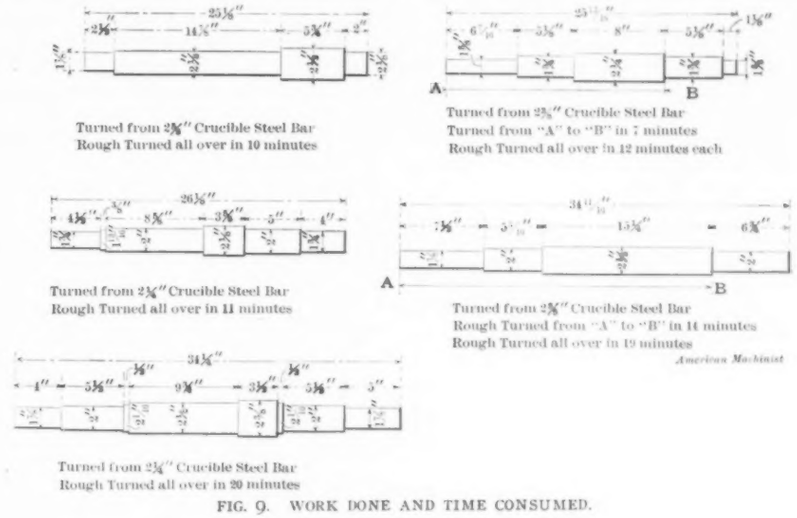

Turned from 2⅝" Crucible Steel Bar
Rough Turned all over in 10 minutes
A
B
Turned from 2⅝" Crucible Steel Bar
Turned from "A" to "B" in 7 minutes
Rough Turned all over in 12 minutes each
Turned from 2¾" Crucible Steel Bar
Rough Turned all over in 11 minutes
A
B
Turned from 2¾" Crucible Steel Bar
Rough Turned from "A" to "B" in 14 minutes
Rough Turned all over in 19 minutes
American Machinist
Turned from 2¼" Crucible Steel Bar
Rough Turned all over in 20 minutes

FIG. 9. WORK DONE AND TIME CONSUMED.

Oftentimes a thing does not get a fair show because of a poor one that is not a fair representative of its class, and things are judged and condemned because of the failure of another somewhat similar one that is really not a sample at all. I have one such case in mind that will serve as an illustration.

A firm wished to enlarge their line of manufacture somewhat by making some additional sizes of machines, and wishing to have everything up to date they decided that some "technically educated" assistance would be a good investment. After some looking around they procured the services of a graduate of a well known college. They had always heard this college well spoken of as a manufactory of high-class education, and as the "sample" which they secured had the college brand blown in in the way of certain mysterious letters after his name, and a diploma, they had reason to think it genuine.

The first few weeks did not develop anything startling, except the great amount of time it took to design and make drawings for a small detail which it was desired to change for something which did not have the defects which continued use had shown that their then present one possessed.

The next job this "sample" was given to do was to figure out sizes, and to make drawings for a larger size of machine of a type the firm was making. After he had been working at it for several days, he came down into the office and informed the firm that he had come down to see on what terms they would take him into

the company. He felt, so he said, that he really could not let them have the benefit of his ability unless he was to share in the benefits. This was in spite of the fact that the firm had hired him and had agreed to pay him what had seemed to them to be a big price for this very "technical" knowledge which he was supposed to possess, and which was above anything which they possessed.

I know that there are some people around that shop who judge technical education by that "sample," and it does not do much good to tell them that the sampling was not fairly done, and that they did not get a fair average specimen; and their experience and their opinion help to form opinions for their friends, who may not need technical help at present, but might need it in the future.

After some persistent effort, and with the help of some friends who were interested in seeing that he got a chance in life, a young man got into a machine shop. He was "willing to do anything," so he said, and was put to work running a drill press. He did not know anything about shop work, as he had worked in a sawmill, on a farm, and delivered goods for a store, what time he had worked before he got this job.

He was not the kind of a man that the foreman generally takes too. He was slow, and not any too accurate in his work. He had a way of speaking that was disagreeable, although not pronounced enough to be termed distinctly disrespectful; and above all, from the foreman's point of view, he had a way of not being regularly at work. If he showed any real ability it was in laying off without saying anything about it, and then coming back with an excuse that seemed to justify his absence, and in telling how he was interested in the work of the company, and how hard he was exerting himself in their behalf.

One day he walked into the superintendent's office and, without being asked to do so, dropped down into the spare chair that was kept for anyone who might drop in on a matter of business.

The superintendent looked at him in some surprise, and asked, "What is the matter now?"

"I just came in to have a little business talk with you," the man replied, with the air of one who was conferring a favor.

The superintendent was used to having his men talk to him on business on all sorts of subjects, from what to use for bait for fishing, or the kind of candy a girl likes best, to inventions which would revolutionize the mechanical world, but they usually took an opportunity when he was near their work to open up the subject. This must be an exceptionally important subject that would cause a man to leave his work, and make a special visit to the office to bring it up. He was busy but would spare a minute. "I am always ready to attend to any business that concerns the interests of the company. What is this business that you want to see me about?"

"I want to know how soon you are going to put me on a lathe?" This was asked much in the same way a man would ask what wages the job he was at paid.

"I don't know of any reason at present why I should ever put you on a lathe. I do not usually advance a man from the job he is at until I think he is doing it so well that he is capable of better work, and I have never as yet had the least idea of that kind in your case. I am not even sure that I shall keep you on the job you are now at. If I do it will be because you improve some over what you have been up to now."

"Ed used to run the drill press, didn't he?"

"Yes, he did. He was a first-class man there and now he is a first-class lathe man, and he got put over on the lathe because he was too good a man to keep on the drill press, and he didn't have to ask to be put on a lathe either."

"Sam used to run the drill press, didn't he?"

"Yes, Sam has run nearly every machine in the shop. He served a regular apprenticeship, and worked for low wages for the sake of getting a chance, and he made the best of the chance when he did get it. You are not in the same class with either of those fellows, and you will have to train very carefully if you ever get in."

"Then you don't know when you will put me on a lathe?" It was more a declaration than a question.

"I don't know now and I am afraid that it will be a long, long time before I do know. You still have a chance to show what you can do out at the drill press."

The interview closed, but it was not very long before the man quit the job and explained to his friends that they were all too narrow minded to give a good man a show in that shop.

If he should get among college men and pass as a "sample" of the mechanic educated in the average machine shop, it would be rather hard, but I have no doubt that by this time he would be willing to take any kind of a job in a machine shop, from general foreman down.

In each of these cases it may be that the effort was to have "gall" take the place of ability, and both come from classes which cannot be judged by "sample."

W. OSBORNE.

Founders' Day at Lehigh.

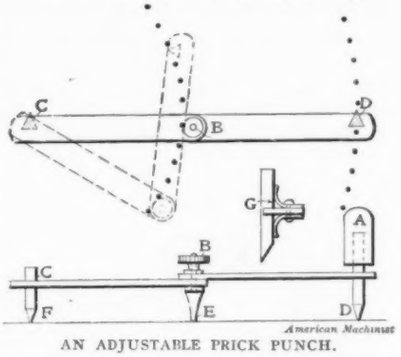
On October 12 the twenty-sixth celebration of Founders' Day at Lehigh University, Henry Sturgis Drinker was inaugurated as president and the first sod was turned in preparation for the erection of Drown Hall in memory of the late president.

An electrician is always posted on current topics.

Letters to the Editor.

Adjustable Prick Punch for Circular Work.

The illustration shows a convenient tool for the use of those who have occasion to prick-punch circular lines to drill or work to. Three-cornered steel is used for the punches to enable the prick-punch points to be brought close together for very small circles. The hammer *A* is a loosely--sliding head on the punch. The punches are held to the radius bars by spring clamps as



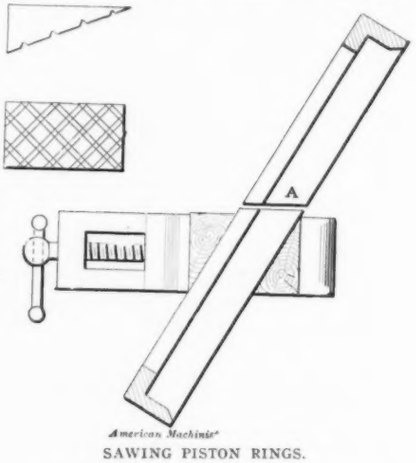
AN ADJUSTABLE PRICK PUNCH.

shown at *G*. The tool rests on the work at three points, *F E D*. This keeps the punches upright without care. It will often be found well to prick-punch a second line inside the finishing line. This is to enable corrections to be made before it is too late. The nurled nut *B* clamps the two members of the device so that the centers are the desired distance apart.

S. W. B.

Sawing Piston Rings.

The sketch shows the plan of a vise on a Millers Falls hack-saw, with a large piston ring shown in section, gripped by



SAWING PISTON RINGS.

two taper blocks of wood with serrated faces. The blocks are made of hardwood to the required taper, and the piston ring is gripped so that its center is just clear of the vise edge and in a vertical line with the saw blade. The blade and moving parts of the frame pass through the bore of the ring and saw the ring in two at *A;* the edges then only require trimming up

with the file. Piston rings, from 12 to 50 inches can be sawn in this manner much quicker than by hand, and with less breakage of saw blades. W. D.

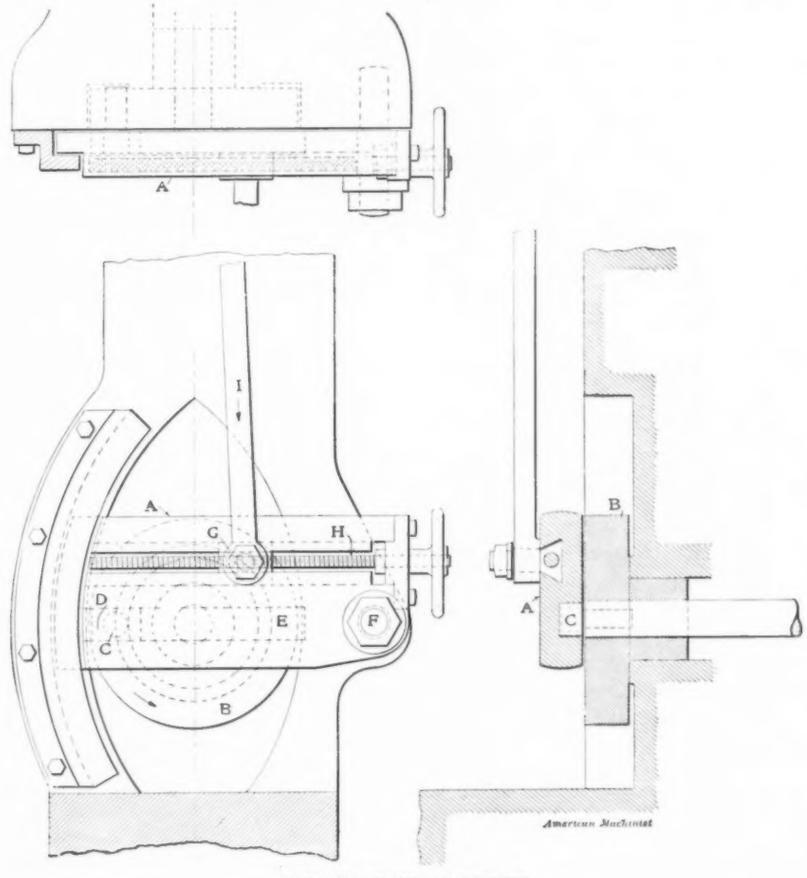
Y——, England.

Adjusting the Slotter Stroke Without Stopping the Machine.

There are readers of the AMERICAN MACHINIST who operate slotting machines and also help to build them, and I suppose some of them have wished there was a way to construct such machines so that the stroke of the cutter bar could be changed while the machine was in motion, as is done with the pillar shaper. I have one way of doing it, and herewith send you the necessary sketches. Referring to these, it will be seen that the arrangement provides for a quick return motion, thereby doing away with the quick return on the back of the machine, the driving gear being keyed rigidly to the shaft.

The plan and front view show the arrangement on the front of the slotter, with the cutter bar and its guides removed. The section is through the center.

As will be seen, I use a yoke *A*, which



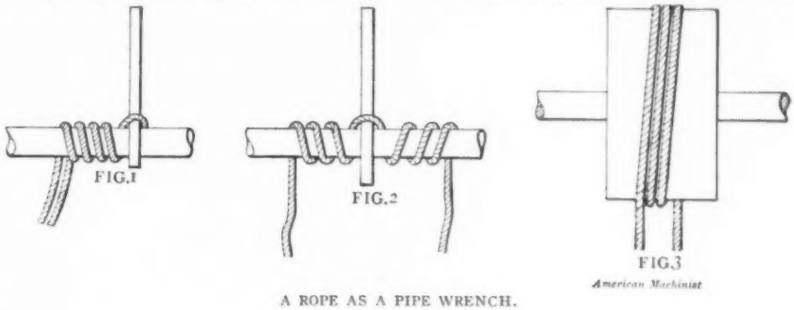
SHOWING FRONT OF SLOTTER.

receives motion from the disk *B* through the stud *C* and block *D* working on the slideway *E* in the back of the yoke. Disk *B* revolves in the direction of the arrow and causes the yoke to move up and down about its fulcrum, which is at *F;* it will, of course, move faster on the upstroke than on the down or cutting stroke.

Changing the stroke is done by moving the crank-pin block *G* along its groove by the handle on the screw *H*. Block *G* is connected to the cutter slide by the connecting link *I*. C. W. J.

A Rope as a Pipe Wrench.

Fig. 1 shows a "one-man" rope pipe wrench. The ends of the rope are held in one hand while the toggle is pulled with the other. The arrangement at Fig. 2 is for heavier work and requires two men, one to hold the rope ends and one to handle the toggle. Fig. 3 shows a method of grinding a pulley on a shaft, or grinding a shaft in the boxes. The ends of the rope are pulled alternately, or a toggle—as at Figs. 1 and 2—may be used.



A ROPE AS A PIPE WRENCH.

HERMAN JONSON.

[The device shown at Figs. 1 and 2 is called a "Spanish windlass" and is used much by seafaring folk. The hand-rails of marine engines are polished by using a device similar to Fig. 3. A piece of emery cloth is wound around the rail and then a piece of spun yarn is wound around the emery cloth, and the fireman, pulling the ends of the spun yarn alternately, polishes the rail.—Ed.]

Copied Inventions.

As the article by "Entropy," at page 473, winds up with an interrogation point, I take it that replies are in order. While it is a trifle difficult to form an opinion that would be just to both parties from the meagre details he gives us, I should say that, on general principles, if the well-known shop that is now manufacturing the device he invented is doing so through leakage of one of the men to whom he trusted the secret, he would not only be justified in taking up its manufacture in competition with them, but that he is, ethically, entitled to something in the way of compensation from said well-known shop.

If, on the other hand, he put his invention on the shelf, making no effort to get it before the public, and someone else actually re-invented the same device without knowledge of his having previously done so, which has been known to happen, and this someone put it before the public and built up a line of trade in consequence, then "Entropy" has no right to do anything which might injure such business.

The man who merely invents a thing, puts it aside and gives the public no chance to benefit from it, has done nothing to entitle him to any remuneration whatever, and the mere fact of his being the prior inventor should not, ethically at least, work to the disadvantage of another who puts the same device on the market unless the idea has been stolen from its original inventor.

If my information is correct, the U. S. Patent Office has, as one might say, taken cases of this sort out of the jurisdiction of ethics and holds that, according to law, if a man invents a device and does not give it to the public within two years from the date of its completion, anyone who is so fortunate as to hit upon the same idea may get it patented, leaving the prior in-

ventor no rights whaever in the matter; and this seems like law and justice, as well as ethics. E. R. PLAISTED.

Two Tools for Gripping Tubes on the Inside.

Fig 1 shows an excellent tool used for screwing in boiler and condenser tubes where one end of the tube is threaded and screwed into a head tapped to receive it, and the other end passes freely through a reamed hole. When the tube is screwed tight into place the unthreaded end in the reamed hole is expanded.

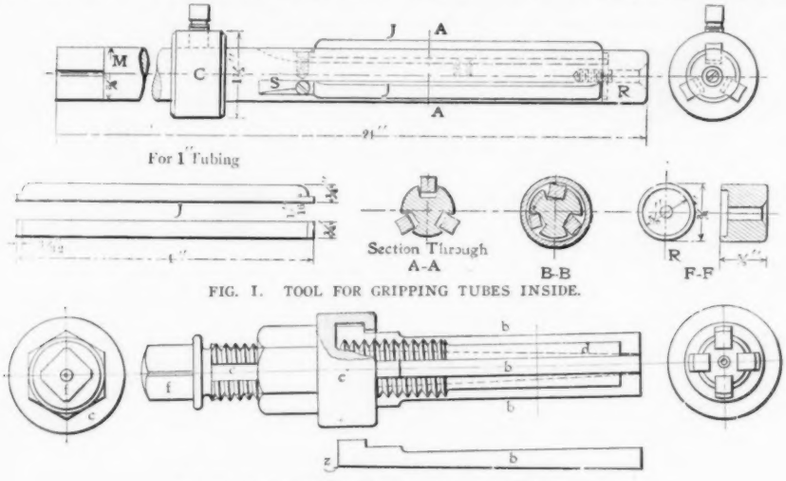


FIG. 1. TOOL FOR GRIPPING TUBES INSIDE.

FIG. 2. EXPANDING MANDREL FOR GRIPPING TUBES.

The tool consists of the mandrel *M* with three grooves of sufficient length milled in the end to receive the blades *J*.

Referring to the sectional view, *A A* shows the form of groove used. It is important to have the bottom of the groove the same width as the thickness of the blades *J*, but the sides widening at the top to give sufficient clearance to allow the blades to rock, as shown at *B B*, which illustrates its action in a tube. It will be noticed that the tendency of the square blade is to roll on the corner at the bottom of the groove when the tool is turned, causing the edge diagonally opposite to describe a circle away from the center, thus giving it a tendency to grip tighter as greater force is exerted upon it.

The blades are made as shown in the separate view. The small projection at each end is for the purpose of retaining them in the grooves with the aid of the cupped end-piece *R* made as shown at *F F*—the end of the mandrel or spindle *M* being turned to fit the cupped portion. The screws *S* with thin, flat heads are set into the other end of the grooves a distance from the part *R* sufficient to allow free motion up and down and rock to the blades *J*, but not to allow them to fall out. Coiled springs are let into the bottoms of the grooves, to keep the blades pressed outward and assist in making the blades take hold. A collar *C* is provided with a set-screw, as shown, to stop the tool at any prescribed depth in the tube. The tool does not have much of a range, taking only the variations found in one size of tubing.

In use the tool is slid into the tube and turned in either direction as the case may require, as it works equally well in either direction, and when the desired operation is finished the tool is pulled out.

Usually it is best to set the coller *C* to bring the blades directly under the threaded part of the tube to avoid some of the twist likely to take place in light tubing, and when used in that position where the tube is supported by the head it works with less liability to distort the tube. Concave the tops of blades to give better grip.

Fig. 2 shows a mandrel used for screwing tubes or bushings into any place where it is not convenient or possible to grip the outside, or where conditions require the bore to remain uninjured during the operation of screwing in by any form of driver that acts like a pipe wrench. The tool consist of the mandrel *f e d*, the sliding tapered jaws *b*, and nut *c*. In use, the mandrel is slid into the bushing and a wrench on *f* prevents turning while the jaws *b* are drawn up the taper by the nut *c*.

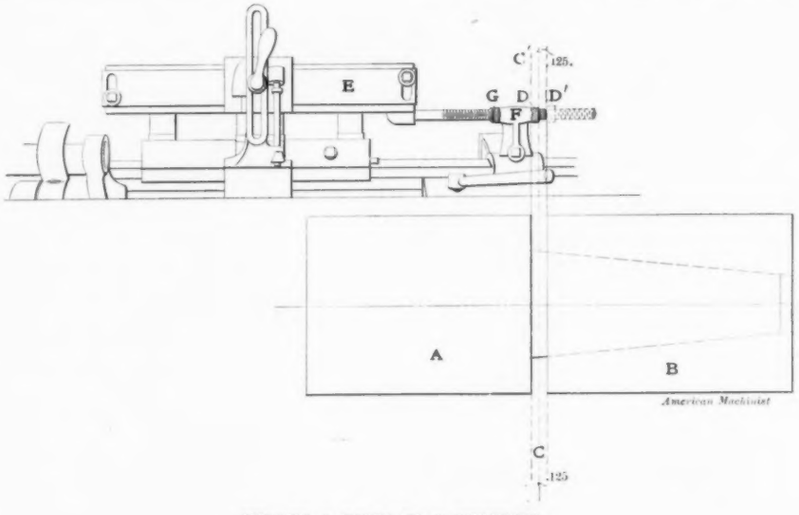
W. M. Fox.

Seating a Taper to a Shoulder.

After finding the taper wanted by the old "cut and try" method which is used in most shops and practically unavoidable, I found myself up against a lot of taper turning that had to fit the taper tight enough to resist a powerful pull (taper swaging punches), and being bothered with some of them remaining in the work after the slide returned, others fitting so tight in the taper in the slide that we had to batter things up before we could get the punch out; this started me to thinking that there ought to be some way of overcoming the guessing about tightness of taper fits and the seating upon the shoulder of the punch shank.

The sketch shows how simply a seemingly impossible problem was solved with the taper attachment on a lathe.

Piece *A* is the work. The taper is turned down approximately (being careful not to disturb the setting of the tool for size at this stage) and just smoothed with a file, then forced into gage *B* any degree of tightness wanted. *C* is the space it lacks of a seat upon *B* (say .125 inch). Turn nut *D* back until you have the same space between hanger *F* and nut *D* as between *C'* and *D'*; take up this space by running the carriage to the left; now tighten nut *G*. This has advanced slide *E*, which advances the cutting tool the proper distance to reduce the diameter of the taper the proper amount to give you the same pressure contact upon gage *B* that you used in measuring space *C*, after smoothing with a file the same as was done for the trial cut.



SETTING A TAPER TO A SHOULDER.

This way of finish-sizing will be the same for all degrees of taper; turning the nuts *G* or *D* the right way to feed the tool into the cut.

If nuts *G* and *D* were made large enough to be graduated and a scale attached to hanger *F* overhanging nuts *G* and *D*, measurements could be made that

would be very handy for turning tapers or facing off shoulders. It makes a good micrometer lathe stop. SCOTTY.

[It is perhaps needless to point out that the usefulness of this plan is by no means limited to those taper fits which have shoulders, but that it may be applied to any taper fitting in either turning or boring.—ED.]

A Drilling and Tapping Jig for Yokes.

Here is a drilling and tapping jig that has proven to be a rapid producer. A side view of the work is shown in Fig. 1, and the end view may be seen in Fig. 2, two pieces being shown in position in the jig. Holes 5/8 inch diameter are drilled at *A* and *B*, and a 7/8-inch hole drilled at *C* and tapped 1/8-inch thread. Previous to drilling, the inside and outside faces of *A* and *B* are straddle-milled to the dimensions given; otherwise the piece is a rough steel casting.

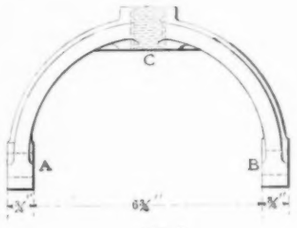


FIG. 1.

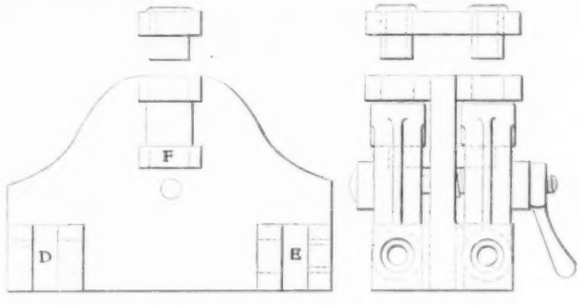


FIG. 2.

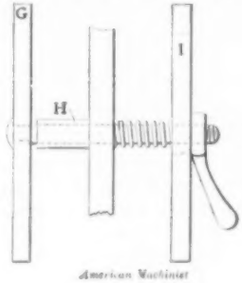


FIG. 3.

A DRILLING AND TAPPING JIG FOR YOKES.

The side view of the jig in Fig. 2 shows the clamps removed. The slots *D* and *E* are milled, so that ends *A* and *B*, Fig. 1, fit in nicely; *C* rests on lug *F*.

The drill bushings for the tapped hole are fitted in a plate, as shown above. They are slightly tapered, and fit easily in the similarly tapered holes in the jig. This construction allows them to be easily removed for the tapping operation, and does away with the use of set-screws for holding them while drilling.

The clamping device is shown in Fig. 3. The clamping stud is firmly riveted to the clamp *G*. *H* is a loose collar made of tubing which prevents *G* from sliding in toward the jig, but is short enough to allow the work to be clamped. A spring holds the other clamp *I*, which is slotted between the dotted lines.

To remove the work from the jig, the lever is given one turn, which allows the slotted clamp to be moved around and down out of the way. The work may then be removed on that side, and the clamp *G* pushed over, so as to allow the work on the other side also to be removed.

A "Magic" drill chuck and collets are used in drilling to save time in changing drills. Parallels are clamped to the drill-press table to prevent the jig from turning while drilling and tapping the large hole. All the drilling and tapping is done before the work is removed from the jig.

O. L. LEWIS.

Machining a Small Slot in a Sleeve.

The accompanying sketches show a method of machining a slot in a gas-engine governor sleeve. Referring to Fig. 1, which shows the sleeve, it will be seen that the slot is 9-16 inch long by 1/4 inch wide. These slots were usually drilled, clipped and then filed. This process became a tedious one to me, and so by applying my thinking cap, I succeeded in doing the job in less time by the use of the set of fixtures in Fig. 2, which included a stud, V-block, nut, lathe dog and a 1/4-inch straight reamer. As will be seen, the stud is clamped on the V-block, which block is provided with a stud for fastening it to the drill-press table. A small collar fits into the countersunk portion of the hole drilled through the stud. A 3-16-inch hole is drilled through this collar, and notches filed to receive the lands of the 1/4-inch reamer, which drives the collar, thus forming an ample bearing. A 1/4-inch hole is first drilled through the governor sleeve at *A*, and then it is slipped onto the stud, and next the nut is screwed on against the face marked *B*. Next a lathe dog is fastened to the sleeve at *C*, the end of the dog resting on the drill-press table. The reamer is then chucked and inserted through the hole *A* into the small collar which has been placed in position in the stud. In operating, the end of the lathe dog is held firmly against the table, and a pin is used to turn the feed nut, thus feeding the work against the reamer.

A. B. GINNER.

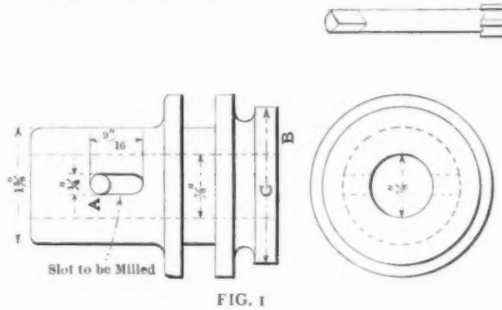


FIG. 1

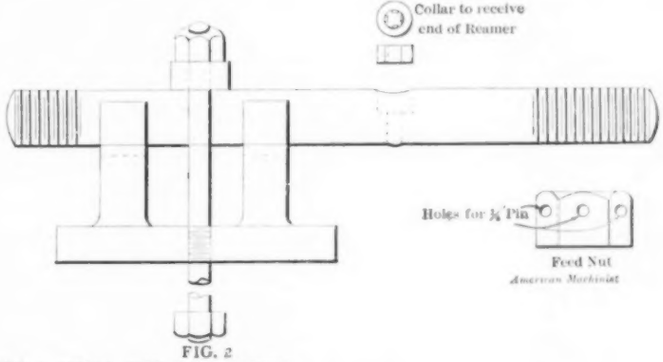


FIG. 2

TOOLS FOR MACHINING A SMALL SLOT IN A SLEEVE.

Obeying Orders.

Patrick McCarthy was a laborer in the foundry. His tendency to get drunk and thereby periodically absent himself from work was equaled only by his insistent desire to get back on the old job as soon as sobered up. He had been "discharged" half a dozen times, and just as often had the next Monday morning found him back in the yard scraping castings.

But when, two days after Labor Day, Pat had not shown up, the disgusted superintendent decided to settle McCarthy's case for once and for all, and wrote a letter informing him that he was abso-

lutely discharged and that it would be useless for him to ever again apply for work at the foundry.

The preliminary remarks of the superintendent the next Monday morning, on spying Pat complacently wielding his hammer and chisel in the same old place in the same old way, are better fitted to imagination than publication. Finally he said: "McCarthy, what business have you around here? Didn't you get my letter stating that you were permanently discharged?"

"Sure and Oi did that, sor," replied Pat; "but didn't it say on the outside iv the onvelope to return in four days? Well, the four days is up, and here Oi am."

Pat is still back in the yard chipping castings. W. L. C.

A Punch and Die for Templets.

It often occurs on engine work that we have a special head or flange to drill, and while we do not care to make a jig, we wish to preserve a record of it. A sheet-iron templet is the cheapest solution of the problem, and the punch and die shown at Fig. 1 is of great assistance in making

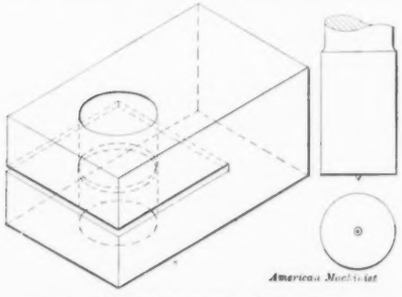


FIG. 1. PUNCH AND DIE FOR TEMPLETS.

the templet. The die is a block of gray iron with a reamed hole and a slot sawed in the block far enough to admit the templet. As the holes generally occur near the edge, the slot need not be very deep. We lay out the templet and make a center-

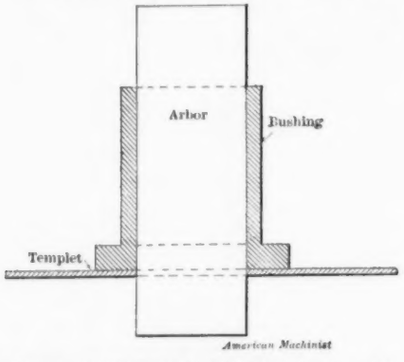


FIG. 2. CONVERTING A TEMPLET INTO A JIG.

punch mark, insert the templet in the slot, drop the punch into the hole, and have no trouble in finding the punch mark. A sharp blow with a hammer will punch the hole out clean. If we discover we have enough use for this templet to justify the outlay, we can locate bushings by means of an arbor (see Fig. 2) and solder them to the templet, thus converting the templet into a jig.

We have also used this system in making jigs with gray-iron plates, by laying out a center and two holes on a sheet-iron templet and soldering bushings on as described. We could make the jig on a drill press and have it come within the "good-enough" limit. ISAAC MORGAN.

Supporting Shafting.

Supporting shafting with standard structural shapes is probably not a novel method; however, it is not as generally used as it might be with advantage. Figs. 1 and 2 show how standard angles were used for this purpose, being attached to the bottom

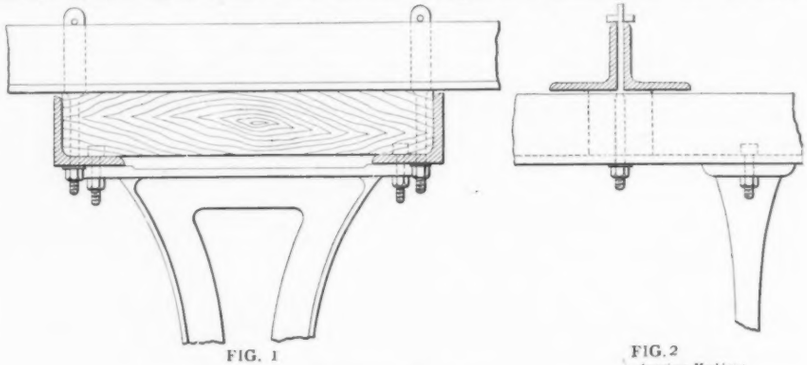


FIG. 1 FIG. 2

SUPPORTING SHAFTING.

members of some iron roof trusses, this portion of the trusses being also composed of two angle irons placed about ⅜ inch apart. Bolts were flattened, as shown, to pass between the angles of the truss, and fastened by a pin through the upper end; wooden blocks were placed at each truss to hold the angles the correct distance apart to suit the shaft hangers. The use of nut locks will insure a lasting tight job.

J. E. TERMAN.

Twe Simple Milling Fixtures.

The enclosed sketches show two simple milling-machine fixtures for operating on

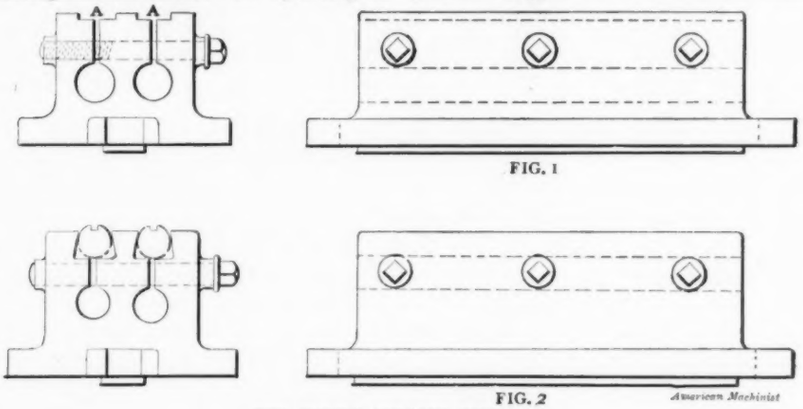


FIG. 1

FIG. 2

TWO SIMPLE MILLING FIXTURES.

two pieces at a time. Fig. 1 is for holding thin metal strips which have previously been milled on their edges, admitting of their being clamped in recesses *A A* by means of the three bolts shown. Fig. 2 is a similar fixture used for the milling of keyways in small gun-rod stock.

A. JACKSON.

Setting Crank Centers.

I take off my hat to Mr. Mortimer Parker for his article at page 471, Part 2, Vol. 28. His criticism of my article is just and good. I know more about crank centers now than I did when I wrote that article, and I think he does, too. After all, where they make a business of turning cranks, they do not use crank centers at all, but special machines. I wonder what he would think of the way we made a built-up crank a few days ago. A party brought in a small crank—out of bicycle motor—in which the shaft and pin were loose in the disk. We rebored the disks, making the holes much larger and of different sizes. We put a short mandrel through the two of them and clamped them to the faceplate and rebored the pin holes. With this style of crank it is very hard to get the parts assembled in line. Instead of making the shaft in two parts, we made it in one. We heated both disks (we do not happen to have a press), having secured the shaft in the vise. When they were hot enough we slipped the one with the larger hole on first, stuck in the pin, then slipped the other one on. After the two ends were finished to size, we took a hacksaw and cut out the piece between the two disks. When we put it back in the lathe to test it, we found it

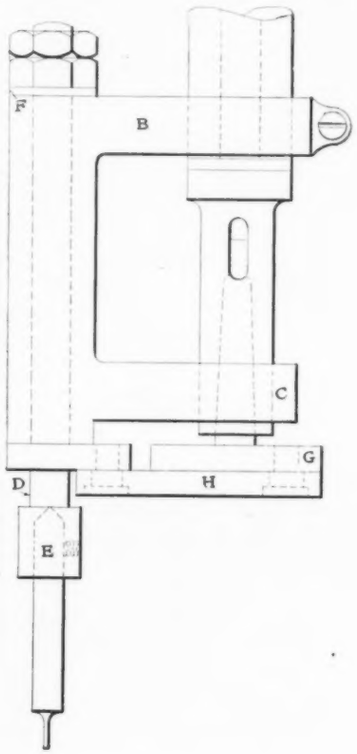
all right. Of course we pinned the shafts in the disk to help the shrink-fit to hold.

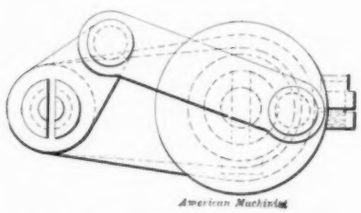
I am sorry Mr. Parker did not give his address. I would like to write to him.

W. A. BRIGHT.

Rig for Grinding Valve Seats in Automobile Cylinder Heads.

Our firm had a contract to machine and test 1,000 cylinder heads for automobiles, each having two valve seats. This makes 2,000 valve seats, 1 7-16 inch largest diameter with 3-32-inch seat. They were reamed with a rose reamer and then ground by hand. One man could grind on an average 20 seats in 10 hours. As the





RIG FOR GRINDING VALVE SEATS.

contract called for 20 heads per day, it would keep two men grinding.

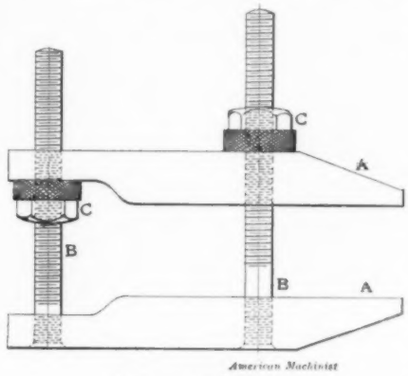
We designed a fixture that was put on a drill press, with a box jig to hold the heads on the driller bed, and a boy was able to grind 60 seats per day that were tested to 150-pounds pressure.

In the sketch *A* is the drill-press spindle and *B* a brass casting with a clamp-screw to hold it on the spindle sleeve. The lower arm *C* of this casting is bored a working fit for the spindle. *D* is made of steel bored at *E* to hold a screwdriver and threaded at the upper end for lock-nuts to take up wear. *F* is a washer. Disk *G* has a shank which fits into the drill-press spindle, and is connected with *D* by link *H*. The revolving of driver *G* gives an oscillating motion of a little over 1-5 of a turn, which is all that is required.

THE APPRENTICE.

A Machinist's Parallel Clamp.

The illustration shows a very handy toolmaker's parallel clamp. It consists of



MACHINISTS' CLAMP.

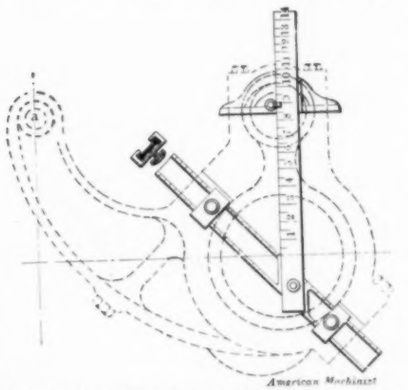
six pieces of machine steel, case-hardened. *A A* represent the clamp jaws, *B B* the binder screws (threaded and riveted into lower jaw, passing through clearance holes in upper jaw, thus bringing both binder screws on the same side of the clamp), and *C C* the special lock-nuts placed as shown in sketch.

It is obvious that this tool may be used in many places where the old-style parallel clamp with a screw on each side of the jaws would be unhandy.

W. W. PATTERSON.

A Gage for Laying Off Special Eccentric Straps.

The dotted lines show an eccentric strap for a certain line of engines. These straps



GAGE FOR LAYING OFF A SPECIAL ECCENTRIC STRAP.

are of the same pattern and only differ in point of size. The 45-degree gage shown was made to lay out these straps. The graduations on both the blade and beam start in the center, which is also the point on the drawing from which all dimensions are taken. It will thus be seen that by raising the sliding head and cleats it becomes a very simple matter to lay out the strap. To locate the hole *A* we reverse the instrument and measure out from the blade along the line of the sliding head.

ISAAC MORGAN.

Wanted, a Method of Brazing Gray Iron.

We have received an inquiry for a method of brazing gray iron. As we are not in possession of the desired information, we refer the matter to our readers.

An Appreciation.

I like the different things in your paper, like them all, but like "Brutus," not that I love Cæsar less but Rome more, I love to sit in the car and peruse "Echoes from the Oil Country." I don't want to wait until Osborne is dead before I cast a flower, and maybe a brick, before him. I want now to thank him through you for the many happy moments I have enjoyed reading those short stories of varied shop experiences.

Surely the mechanics who read this matter cannot help but be better men, inasmuch as these stories breathe triumph over difficulties, a something better ahead, and, not least in these days of blank swearing in the papers, his is a moral tone.

I do not know how the success of a writer is measured in your paper, but I do know that the shop world in our quarter at least, is better by the men having their hearts gladdened by the reading of these genuine human articles. Mr. Chairman, I thank you.

C. A. SEEGER.

Explosions in the Exhaust Muffler.

An extract from *The Gas Engine*, published in the AMERICAN MACHINIST at page 247, seems to intimate that explosions occurring in the muffler of a gasolene engine arise either from lack of sufficient battery or from too little gasolene; but the writer has found that, in his own practice, such explosions are more apt to be caused by too much, than too little, gasolene; and that the battery oftentimes, like "the flowers that bloom in the spring" has "nothing to do with the case," all of which goes to show that they simply indicate that something is wrong; and that one, on hearing them, should proceed to locate the trouble before trying to remedy it; which, by the way, is a good rule to follow in all cases.

The "shooting," as it is sometimes called, arises from gases which have passed through the cylinder without being exploded there, that's all, and a weak battery, defective contacts or a too weak or too strong mixture may be the cause.

Be it said, however, that a mixture too weak to explode in the cylinder would

be little likely to explode in the muffler, as it stands little chance of being enriched there; while one too rich would certainly be weakened there and so become explosive.

In very cold weather such explosions will often occur at starting, before the cylinder has become sufficiently warmed to properly vaporize the gasolene, even when all adjustments are right, and they are often the result of using too much cylinder oil.

As a matter of fact, while they do not indicate any serious trouble, they may indicate any one of dozens of little shortcomings which it will sometimes puzzle the very elect to find, often some peculiarity confined to the particular make of engine in use.

For "ways that are dark and tricks that are vain" the "heathen Chinee" can't hold a candle to a gasolene engine.

W. D. GRAVES.

German Armor Plate Planers.

BY EMILE GUARINI.

The "Duisburger Maschinenbau-Actien-Gesellschaft, vormals: Bechem & Keetman" have made a specialty, in Germany, of the construction of large planers, and two of their most recent types, which possess interesting characteristics and are intended for machining armor plates, are shown by the accompanying half-tones.

The type illustrated in Figs. 1 and 2 is for planing armor plates 7.5 meters long and 3.5 meters broad, and is arranged to cut in both directions; the rail carrying heads at front and rear and traveling bodily along the ways. The drive is by belt or motor and suitable intermediate gearing. By means of bevel wheels a common driving shaft engages, on both sides, with the lead-screws, which cause the combined housing and rail to move to and fro upon the bed of the machine. The transmitted to the pulley and shaft at the top of the upright by the belt at the right-hand side, and thence by the bevel gear and shafts at the side across to the pulley carried by the bracket at the left side. The open and cross belts drive in opposite direction the pulleys near the left end of the rail, and from these motion is communicated by worm gearing to the traverse screw for moving the head to and fro on the rail. The longitudinal movement of the upright on the bed is controlled by a tappet and lever, which actuate a reversing shaft located along the left-hand way. This shaft controls the bevel reversing gearing for driving the two traversing screws located in the ways. The movement can be accelerated by the aid of a disengaging countershaft. The control of the open and crossed belts is affected by the aid of cams on the head. The rotation of the swiveling carriage is effected from the side by means of a

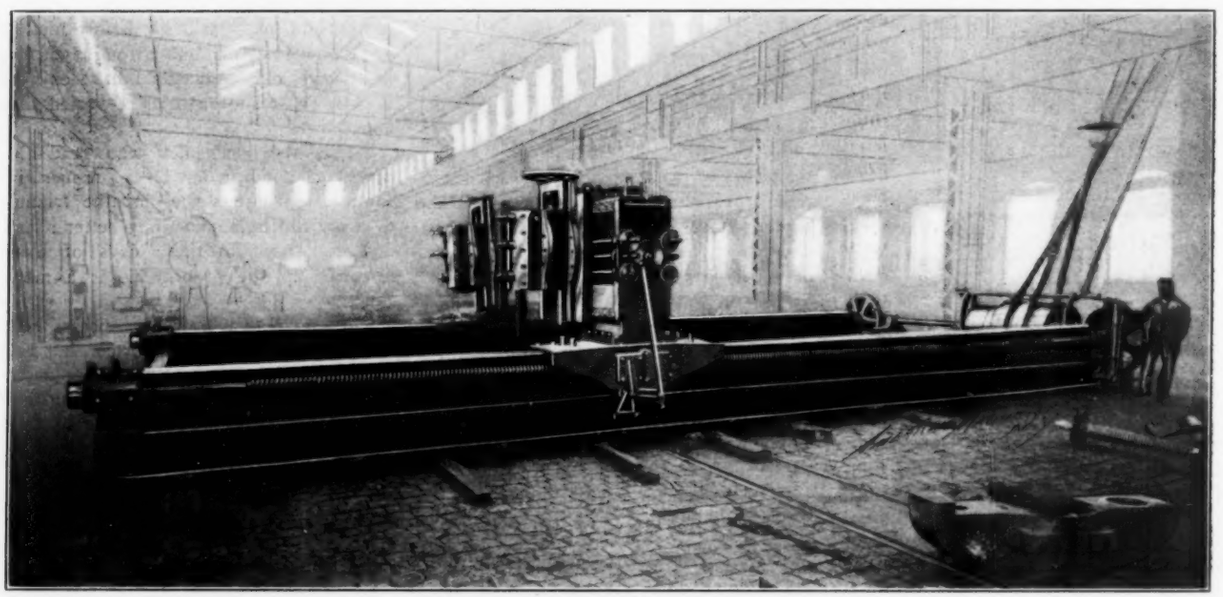


FIG. 1. GERMAN ARMOR PLATE PLANER.

vertical movement of the heads, and their lateral movement to right or left, are effected by means of rack and gearing. In the most recent types constructed the heads may also be inclined at any desired angle in relation to the rail. The armor plate to be machined may be secured between the ways upon two longitudinal rails provided especially for the purpose.

The universal planing machine in Fig. 3 is for providing the plates with both straight and oblique faces. The plate to be treated is secured either flat upon the clamping devices attached to the base-plate, or else vertically between them. The movements comprise a working motion of the head and a movement of the entire machine over the bed in a longitudinal direction. The necessary power for driving the machine is transmitted by means of a countershaft and belting, or, where desired, from a motor. Power is ratchet. The elevating screws for the rail are operated by the shaft and friction gearing on the upright. The horizontal movement of the swiveling slide is by means of the gearing and screw shown at the right-hand end of the cross-rail.

What appears to be a unique mode of making washers and similar annular articles is the subject of U. S. Patent No. 800,020; it consist of upsetting the end of a rod, and then stripping the upset portion backwardly from the rod. One method of doing this is described as holding the rod in a die, one end projecting; the projecting end is upset against the die, then the rod is fed forward, the upset portion being forced back over the rod, stripping it loose from the rod.

Comment in grocers' journals regarding "the man behind the label" is not meant to apply to the story of a reservation Indian who, after living through the winter on canned goods, came to the fort in the spring and hearing a few bars from the phonograph, remarked, with a wry face: "Um-m-m-m! Canned man!"—*Dixie Miller.*

There has been a great deal of trouble with the very large train sheds owned by various railroad companies in St. Louis, Chicago, Jersey City, New York and Boston, due to the fact that the gases emitted from the smokestacks of the locomotives rapidly rust the iron framework of the roofs, and let the structures go to pieces rapidly. It is now announced that the Pennsylvania railroad will, in the case of its Jersey City terminal, replace with copper at fast as the ironwork gives out, or, at least, will cover the ironwork with copper in such a way as to prevent the gas getting access to it.

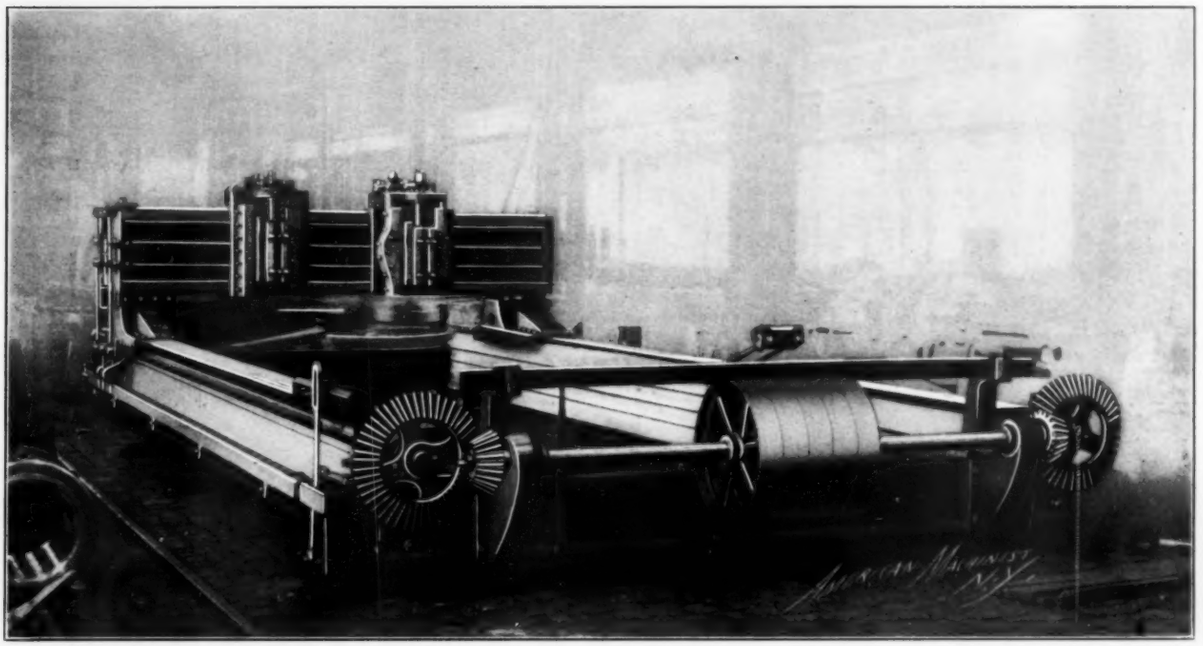


FIG. 2. GERMAN ARMOR PLATE PLANER.

In the case of the new terminal of the Lackawanna system, at Hoboken, no attempt will be made to build a train shed, but the trains will come in between concrete platforms, the platforms only being covered; and we understand this plan was adopted because it was doubted if a train shed could be built which would be a permanent structure.

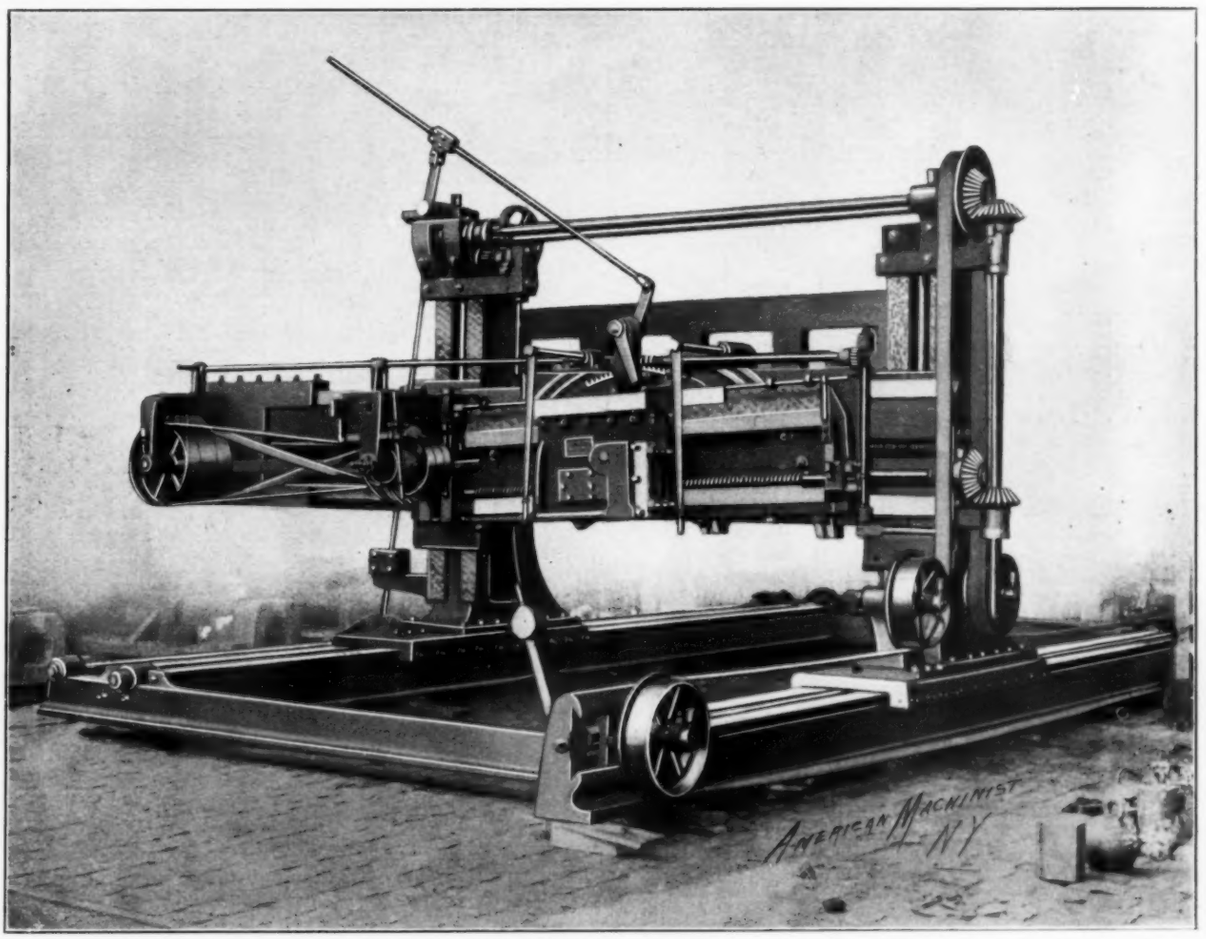
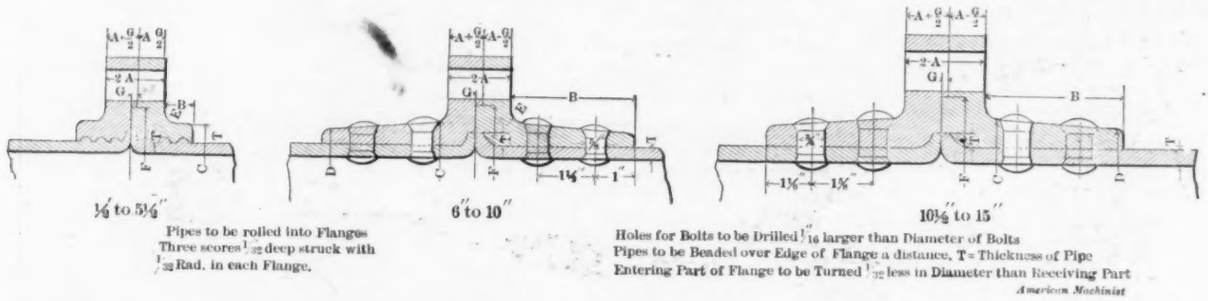


FIG. 3. GERMAN ARMOR PLATE PLANER.

Standard Dimensions of Rolled and Riveted Steel Flanges for Steel Pipe.

BY A. H. NOURSE.

The increasing use of tubular boilers for marine work, with the accompanying increase of pressure, has made the use of steel pipe a necessity, and the accompanying table gives the dimensions of flanges for such pipe.



Pipes to be rolled into Flanges Three scores 1/32 deep struck with 1/32 Rad. in each Flange.

Holes for Bolts to be Drilled 1/16 larger than Diameter of Bolts
Pipes to be Beaded over Edge of Flange a distance, T = Thickness of Pipe
Entering Part of Flange to be Turned 1/32 less in Diameter than Receiving Part

American Machinist

	PRESSURES FROM 101 TO 300 LBS. PER SQ INCH												PRESSURES FROM 301 TO 500 LBS. PER SQ INCH												
	DIMENSIONS OF FLANGE								BOLTS			RIVETS	DIMENSIONS OF FLANGE							BOLTS			RIVETS		
INTERNAL DIAM OF PIPE	DIAMETER	MEAN THICKNESS A	DEPTH OF BASE B	DIAM OF BOSS C	DIAM OF BOSS D	RAD OF FILLET E	DIAM OF FEMALE PART F	DEPTH OF FEMALE PART G	NUMBER	DIAMETER	DIAM OF PITCH CIRCLE	PITCH	NUMBER IN EACH ROW	DIAMETER	NUMBER OF ROWS	DIAMETER	MEAN THICKNESS A	DEPTH OF BASE B	DIAM OF BOSS C	DIAM OF BOSS D	RAD OF FILLET E	DIAM OF FEMALE PART F	DEPTH OF FEMALE PART G	NUMBER	DIAMETER	DIAM OF PITCH CIRCLE	PITCH	NUMBER IN EACH ROW	DIAMETER	NUMBER OF ROWS	INTERNAL DIAM OF PIPE
1/4	3 1/2	1/2	1/2	1 1/8		1/16	1 1/16	1/8	3	1/2	2 1/4	2.880	NONE	NONE	NONE	3 1/16	1/2	1/2	1 1/16		1/16	2	1/8	4	1/2	2 11/16	2.209	NONE	NONE	NONE	1/4
3/8	4	1/2	1/2	1 1/8		"	2 1/16	"	4	1/2	3	2.356	"	"	"	4 1/16	5/16	5/16	1 11/16		"	2 1/8	"	4	5/8	3 7/16	2.700	"	"	"	3/8
1	4 1/2	9/16	9/16	2		"	2 1/16	"	4	1/2	3 1/2	2.650	"	"	"	4 1/16	5/16	5/16	2 1/16		"	2 1/4	"	5	5/8	3 11/16	2.317	"	"	"	1
1 1/4	5 1/8	9/16	9/16	2 1/4		"	2 1/16	"	5	5/8	3 1/8	2.434	"	"	"	5 1/16	5/8	5/8	2 1/16		"	3 1/8	"	5	5/8	4 1/16	2.552	"	"	"	1 1/4
1 1/2	5 1/2	9/16	9/16	2 1/8		"	2 1/16	"	5	5/8	4 1/8	2.592	"	"	"	5 1/16	5/8	5/8	2 1/16		"	3 1/8	"	6	5/8	4 1/16	2.258	"	"	"	1 1/2
2	6 1/2	5/8	5/8	3 1/8		1/4	3 1/16	"	6	5/8	5	2.552	"	"	"	6 1/16	11/16	11/16	3 1/16		1/4	4 1/16	"	6	7/8	5 1/16	2.749	"	"	"	2
2 1/2	6 1/2	5/8	5/8	3 3/8		"	4 1/16	"	7	5/8	5 1/8	2.412	"	"	"	7 1/16	11/16	11/16	3 5/16		"	4 1/4	"	7	3/4	5 1/16	2.608	"	"	"	2 1/2
3	7 1/2	11/16	11/16	4 1/8		"	5 1/8	7/16	8	3/4	6 1/16	2.430	"	"	"	7 1/16	3/4	3/4	4 1/8		"	5 1/8	3/16	8	3/4	6 1/16	2.527	"	"	"	3
3 1/2	8 1/2	11/16	11/16	4 1/2		"	5 1/16	"	8	3/4	6 11/16	2.626	"	"	"	8 1/16	13/16	13/16	5 1/16		"	6	"	9	3/4	7 1/16	2.465	"	"	"	3 1/2
4	9	3/4	3/4	5 1/8		"	6 1/16	"	9	3/4	7 1/16	2.553	"	"	"	9 1/16	15/16	15/16	5 11/16		"	6 11/16	"	9	7/8	7 1/16	2.749	"	"	"	4
4 1/2	9 1/2	3/4	3/4	5 1/8		"	6 1/16	"	9	3/4	7 1/16	2.726	"	"	"	10 1/16	1	1	6 1/16		"	7 1/16	"	9	7/8	8 1/16	2.967	"	"	"	4 1/2
5	9 7/8	13/16	13/16	6 1/8		"	7 1/8	"	10	3/4	8 1/16	2.651	"	"	"	11 1/16	1 1/16	1 1/16	6 1/16		"	8	"	9	1	9 1/16	3.258	"	"	"	5
5 1/2	10 3/8	13/16	13/16	7		"	7 1/8	"	11	3/4	8 1/16	2.552	"	"	"	11 1/16	1 1/16	1 1/16	7 1/16		"	8 1/16	"	10	1	9 1/16	3.102	"	"	"	5 1/2
6	11 1/4	7/8	5 1/16	7 1/8	7 1/8	1/4	8 1/16	1/16	11	7/8	10 1/16	2.674	11	7/8	2 1/16-12	12 1/16	1	3 1/16	8 1/8	7 9/16	1/4	9 1/16	3/16	10	1 1/8	10 1/16	3.377	11	7/8	2 1/16-12	6
6 1/2	12 1/16	"	"	8 1/16	7 1/16	"	9 1/16	"	12	7/8	10 1/16	2.711	12	"	"	13 1/16	1 1/16	"	8 1/16	8 1/16	"	9 1/16	"	10	1 1/8	11 1/16	3.554	12	"	"	6 1/2
7	12 1/16	15/16	"	8 1/16	8 1/16	"	9 1/16	"	"	7/8	11 1/16	2.912	13	"	"	14	1 1/16	"	9 1/4	8 1/4	"	10 1/16	"	11	1 1/8	11 1/8	3.581	13	"	"	7
7 1/2	13 1/16	15/16	"	9 1/16	9	"	10 1/16	"	"	7/8	11 1/16	3.060	14	"	"	14 1/16	1 1/16	"	9 1/4	9 1/4	"	10 1/16	"	11	1 1/8	12 1/8	3.536	14	"	"	7 1/2
8	14 1/4	1	"	10	9 1/2	"	11 1/16	"	"	1	12 1/2	3.239	15	"	"	15 1/16	1 1/16	"	10 1/16	9 1/16	"	11 1/16	"	11	1 1/4	13 1/16	3.748	15	"	"	8
8 1/2	14 1/2	1	"	10 1/16	10	"	11 1/16	"	13	"	12 1/16	3.111	16	"	"	16	1 1/16	"	10 1/16	10 1/16	"	12 1/16	"	12	1 1/4	13 1/16	3.584	16	"	"	8 1/2
9	15 1/16	1 1/16	"	11 1/16	10 15/16	"	12 1/16	"	13	"	13 1/16	3.247	17	"	"	16 15/16	1 1/16	"	11 1/16	10 15/16	"	12 1/16	"	12	1 1/4	14 1/16	3.730	17	"	"	9
9 1/2	15 1/16	1 1/16	"	11 1/16	11 1/16	"	12 1/16	"	14	"	13 15/16	3.109	18	"	"	17 15/16	1 1/16	"	12	11 1/16	"	13 1/16	"	13	1 1/4	14 15/16	3.580	18	"	"	9 1/2
10	16 3/16	1 1/16	"	12 1/16	11 15/16	"	13 1/16	"	15	"	14 13/16	3.037	19	"	"	17 15/16	1 1/16	"	12 5/16	12	"	13 1/16	"	13	1 1/4	15 15/16	3.730	19	"	"	10
10 1/2	17 1/16	"	3 1/16	12 1/16	12 3/16	"	13 1/16	"	"	"	15 1/16	3.194	18	3/4	"	18 15/16	1 1/16	3 1/16	13 5/16	12 11/16	"	14 1/16	"	13	1 1/8	16 3/16	3.958	18	3/4	"	10 1/2
11	17 15/16	"	"	13 1/16	12 15/16	"	14 1/16	"	"	"	15 15/16	3.311	19	"	"	19 1/16	1 1/16	"	13 5/16	13 3/16	"	15 1/16	"	13	1 1/8	16 15/16	4.094	19	"	"	11
11 1/2	18 15/16	1 1/16	"	13 15/16	13 15/16	"	15 1/16	"	"	1 1/16	16 15/16	3.449	20	"	"	20 1/16	1 1/16	"	14 1/16	13 15/16	"	15 1/16	"	14	1 1/8	17 5/16	3.927	20	"	"	11 1/2
12	19 1/16	1 1/16	"	14 1/16	14	"	15 1/16	"	16	1 1/16	17 15/16	3.362	20	"	"	20 1/8	1 1/16	"	15	14 1/16	"	16 1/16	"	14	1 1/8	18 1/16	4.053	20	"	"	12
13	20 1/16	1 1/16	"	15 1/16	15 1/16	"	16 1/16	"	17	1 1/16	18 15/16	3.361	22	"	"	22 1/16	1 1/16	"	16 1/16	15 1/16	"	17 1/16	"	14	1 1/16	19 1/16	4.362	22	"	"	13
14	21 1/16	1 1/16	"	16 1/16	16 1/16	"	17 1/16	"	18	1 1/16	19 15/16	3.359	24	"	"	23 1/16	1 1/16	"	17 1/16	16 1/16	"	18 1/16	"	15	1 1/16	20 1/16	4.333	24	"	"	14
15	22 3/16	1 3/16	"	17 1/16	17 1/16	"	18 1/16	"	18	1 1/16	20 15/16	3.477	26	"	"	25 3/16	1 3/16	"	18 1/16	17 1/16	"	20 1/16	"	16	1 1/16	21 1/16	4.296	26	"	"	15

STANDARD DIMENSIONS OF ROLLED AND RIVETED STEEL FLANGES FOR STEEL PIPE.

Copper Castings.

Pure copper cannot be cast without blow-holes. For dense copper casting melt in proportions of 200 pounds copper, add, stirring with a "greenwood" stick: 2 pounds cryolite, 8½ pounds sugar of lead (2 pounds powdered borax are often added also). This compound melts smoothly in 10 or 15 minutes. Stir once more with the green stick and pour into the molds.

This compound is malleable and ductile. Copper and cryolite alone is more "tough."

Consul-General Wynne, of London, reports great anxiety in England in regard to the oil trade. He quotes an interview that accords the United States a far more favorable position in the oil world than it had previous to the fires in the Russian oil regions. He states that deliveries at Baku have been getting less and less, partly owing to the interruption of the railway and pipe-line services and partly to the serious strikes and riots at Baku. The stocks at Batoum are practically exhausted, and this is an important factor in the situation in England. The Americans need no longer fear serious competition from Russian oil, but the fact must not be overlooked that Armenia, Galicia, Borneo, Sumatra and elsewhere will now do their utmost to secure the foothold which they have been struggling to get for a number of years.

From Steam to Gasolene.

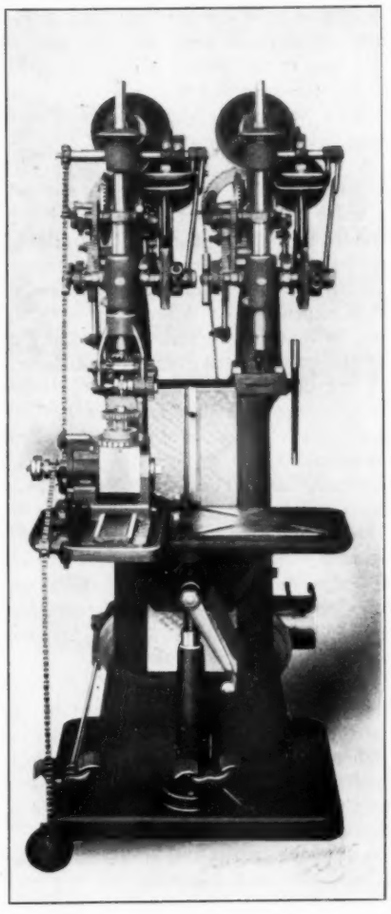
The management of the Ohio River & Western Railroad between Zanesville and Bellaire, Ohio, 112 miles, has decided to broaden the gage for a few miles out from Bellaire by laying a third rail, and to operate that portion by gasolene cars for passenger traffic. If the experiment proves successful it will be extended to the entire line.

Cement for Iron on Iron.

Powdered iron, 60 parts; sal-ammoniac, 2 parts; sulphur flowers, 1 part. Thick paste with water. Use fresh.

Gear Cutting on a Drill-Press.

At page 280, Part 1, of the present volume, we referred to the practice in the shops of the B. F. Barnes Company, at Rockford, Ill., of cutting gears on a specially equipped drill press of their own manufacture. Gear cutting on a drill press will be generally recognized by our readers as very unusual, and we have thought it worth while to secure a photograph of the machine equipped for this work. We find, however, upon further investigation that the attachment has not as yet been arranged for cutting bevel gears, as, in the article referred to, we stated was the case. It is at present arranged only for



A GEAR-CUTTING DRILL PRESS.

spur gears, though we see no reason why a simple modification of it would not adapt it to bevel gears almost as well.

The attachment is shown in the engraving fitted to the regular 14-inch manufacturers' drill, made by the concern named, and is placed upon only one of the spindles, the other being of course available for other purposes. This machine is, and for some time has been, regularly equipped with mechanism by means of which the feed is automatically thrown out when the hole that is being drilled has reached the required depth. The drill spindle is then automatically returned to its initial position, so that when a new piece of work is set, the attendant simply lifts a small trip-lever, when the drill first rapidly descends to the work, and then the regular feed motion is put in. The mechanism for accomplishing the above functions having been already provided upon the machine, it remains only to equip it with the arbor-carrying forked piece seen attached to the spindle, and the device for holding and indexing the gear blanks, to make a gear cutter of it; and, so far as the attendant is concerned, he goes through precisely the same motions that he would were he drilling holes instead of cutting gear teeth, his only duty being to put in blanks and trip a lever at the beginning of each cut. It has been a comparatively simple matter to connect the spindle reversing and feeding motion to the indexing mechanism, and this has been done by means of the chains seen at the left.

It will be understood that the portion of the mechanism which holds and drives the cutter arbor is connected by a dovetailed slide to that portion which supports the gear blank; the two parts of the gear-cutting fixture being thus tied together and the rigidity and swiftness of the device depending upon this entirely and not upon the drill-press frame nor upon the supports of the drill-press spindle within the sleeve and bearings. It makes a very much better gear cutter than it would be supposed possible to make out of a drill-press, and is an interesting example of adaptation.

Record-Breaking Orders for Equipment.

In its issue of October 13 *The Railway Age* recorded orders for 460 passenger cars, 30,620 freight cars and 333 locomotives, and inquiries for additional equipment amounting to 83 passenger cars, 17,060 freight cars and 35 locomotives. The contracts reported this week are even more surprising in many ways, and when taken in connection with the large orders expected from the New York Central, Northern Pacific and other roads, show that the high records of 1901 and 1902 for freight equipment and locomotives will easily be surpassed before the close of 1905, although the volume of orders in those years was exceptional, and notwithstanding the present high prices and the difficulty in securing prompt deliveries.

The orders placed by the Pennsylvania this week for 21,500 cars, in addition to the 16,160 ordered in August, made a new record in contracts placed by a single company, and practically pre-empts all steel-car building facilities during the entire year of 1906. It is stated that all car manufacturers are crowded with orders and that the American Car & Foundry Company alone have unfilled contracts aggregating over 60,000 cars, while no company can promise delivery before the middle of next year unless the order is for a few wooden cars. The greater number of the cars ordered during the current year are yet to be built and will keep the car manufacturers busy until well into the second half of next year.

From the detailed records kept by *The Railway Age* since 1901 of orders placed for new equipment the following totals are taken, the figures for 1905 covering the 41 weeks up to the present:

	1901.	1902.	1903.	1904.	41 Weeks 1905.
Freight cars...	193,439	195,248	108,936	136,561	196,672
Passenger cars	2,879	3,459	2,310	2,213	2,297
Locomotives...	4,340	4,665	3,283	2,538	4,131

It will be noted from the above table that orders for freight cars for the first 41 weeks of the current year are in excess of any previous year, while the contracts for passenger cars and locomotives, if continued at their present rate, will also exceed any previous record.—*Railway Age.*

Locomotives at Purdue.

The experimental locomotive of Purdue University, Schenectady No. 2, which has recently served in an important study designed to determine the value of very high steam pressures, is to be sent to the Schenectady Works of the American Locomotive Company early in November, for the purpose of being fitted with a Cole superheater. It is expected that the engine will be returned with its new equipment early in January.

During the absence of Schenectady No. 2 from the testing plant, a New York Central Atlantic type engine is to be installed upon the plant for use under the direction of the Master Mechanics' Committee on Front-Ends. It is the purpose of this committee to repeat upon an engine of large size the experiments made under the patronage of the *American Engineer* upon Schenectady No. 2, for the purpose of determining the constants in such equations as may be necessary to the logical design of all portions of the front-end mechanism. The Master Mechanics Committee having the matter in charge consists of H. H. Vaughan, superintendent motive power, Canadian Pacific Railway, chairman; F. H. Clark, general superintendent motive power and machinery, C. & N. W. Railway, A. W. Gibbs, general superintendent motive power, Pennsylvania Railroad; W. F. M. Goss, Purdue University; G. M. Basford, American Locomotive Company.

886 Killed; 13,783 Injured on Railways.

In the twelve months ended on June 30, 1905, 886 persons were killed and 13,783 injured in railroad accidents in this country, according to the report of the Inter-State Commerce Commission issued recently. Comparison with 1904 shows an increase of 11 killed and 4,123 injured.

The number of employees killed shows a decrease of 106. There were 1,231 collisions and 1,535 derailments, of which 163 collisions and 168 derailments affected passenger trains. The damage to railroad property was $2,410,671.

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Contents.

	PAGE
Some Interesting Generated Worm Gearing	579
The Divining Rod Again	580
New York-Philadelphia Electric Line	580
A Large Home-made Boring Mill	581
The Liability of the Patternmaker	583
Lang's Lathe Works at Johnstone, Scotland	586
Cement for Iron	591
Studies in Inventive Problems—XI	592
Shot Iron	597
The Lo-Swing Lathe	598
Echoes from the Oil Country—Judging by Sample	601
Founders' Day at Lehigh	602
Letters to the Editor	602-608
German Armor Plate Planers	608
Standard Dimensions of Rolled and Riveted Steel Flanges for Steel Pipe	610
Copper Castings	610
From Steam to Gasolene	610
Cement for Iron on Iron	610
Gear-cutting on a Drill Press	611
Record-breaking Orders for Equipment	611
Locomotives at Purdue	611
886 Killed; 13,783 Injured on Railways	611
An Unique Trade Union	612
New Tools and Machine Shop Appliances	614
New Publications	618

An Unique Trade Union.

It is a fact well understood by those familiar with the machine-tool business that many machine tools have been recently, and are now, sold at prices which do not afford a fair profit to their builders. This condition has come about in various ways, but chiefly, perhaps, by improvements and developments which have largely increased the weights and the shop costs of producing the tools, but which have not been accompanied by proportionate, nor in fact in some cases by any, increase of prices. It is quite natural, therefore, that at the recent convention of the National Association of Machine Tool Builders, the matter of prices should have been discussed and should have received careful attention, as in fact it did. It was on this account that the writer was asked to speak at the banquet on the subject of an organization which has been in operation for some years in Birmingham, England, and which is designed to, and we believe does, obviate many of the difficulties confronting the producers of manufactured goods, yet without trespassing upon the rights of others. We now find in the issue of *American Industries* for October 16 an account of this Birmingham organization, prepared by C. M. Hemingway, president of the Hemingway Paper Manufacturing Company. Mr. Hemingway's account is devoted largely to a description of the personality of E. J. Smith, who devised and is the manager of the organization referred to. These and other signs point toward a more general interest in what has been and is being accomplished in Birmingham (and latterly, elsewhere as well) by this unique organization, and it is perhaps permissible to give here an account of it, largely taken from a presentation of the subject which we published editorially in our issue for February 15, 1900, and in which we referred to an article by Mr. Smith, which had appeared in the *Forum* for January of the same year.

To begin with, it may be stated that Mr. Smith has himself passed through all the stages of manufacturing industry, from apprentice boy to superintendent, manager and proprietor; he being now himself a large manufacturer of metal bedsteads. Birmingham is the center of the metal bedstead trade, which trade had become badly demoralized by what is described by Mr. Smith as "savage and unrestrained competition"; much of the selling having been done at prices that utterly disregarded costs of production, and, in fact, largely by manufacturers who did not know what their own costs were. Profits, for the most part, had entirely disappeared, although the work people, by means of their unions, were enabled to protect themselves to some extent. The manufacturers had an organization, which met occasionally and passed resolutions, which, to quote the words of Mr. Smith, "some of the members intended to carry out"; but under the organization, "honest men lost their trade and the unscrupulous secured it."

Finally, after long study of the situation, Mr. Smith devised a plan, which was adopted, and for about thirteen years it has worked well. Its principles are declared to be, first, selling from well-ascertained costs of production, and, second, co-operating with the work people in securing a fair profit.

Prices at which a member may sell his product are in some lines not fixed by the association, and a manufacturer may sell at any price which suits him; but upon being called upon to do so, he must show that, at the price he is selling for, there is for him at least a minimum profit, previously determined upon as fair, and he must pay to the people who work in his factory the standard wages agreed upon, together with a previously agreed upon bonus, based upon profit.

It will be seen that this leaves each manufacturer free to improve his methods as much as he may choose, or he may produce any grade of goods his trade demands, omitting, if he wishes, any process followed by others in the production of more expensive or different goods. In fact, he may, under this plan, do any of the things that unassociated manufacturers are in the habit of doing to secure trade, except two things: *he cannot sell at a loss, nor, in fact, at a price which does not afford him a profit; nor pay to his employees less than the agreed-upon wages and bonus.*

This is the plan followed in the metallic bedstead industry, where a great variety of bedsteads must necessarily be made, differing from each other very much in style and quality, and, of course, intended to be sold at various prices.

In other industries, however (those in which the product is a standard article and the goods of one factory will sell as readily as those of another), the price is fixed by the association, and no variation from this is allowed, except by consent of the association.

A board, composed of an equal number of employers and employees, decides matters of dispute, and makes, or causes to be made, all investigations as to charges of underselling, costs of manufacture, etc., and it has the power to order the forfeiture of a sum of money, pledged and guaranteed by each member upon joining the association, such forfeiture being imposable for infidelity to the association.

As for workmen's organizations, they agree not to help in any way a manufacturer who forfeits his membership or opposes the association, and any workman who fails to observe this agreement is disciplined by his union. On the other hand, the workmen have an incentive to render efficient service, because the amount of the bonus they receive depends upon the amount of the profits made by the employer, and the association does not re-

strict the profits that may be made, but insists only that *the prices at which a member sells his goods shall afford him at least a minimum rate of profit, based upon the cost of production;* costs being ascertained by the association's standard method. Each member is compelled to learn how to ascertain what his products cost him.

Mr. Smith states in the article referred to, that 90 per cent. of the members of these organizations are perfectly satisfied with their working; the other 10 per cent. he says might well be termed "various," but they are not all fair-minded men. "They have the right to fight for their own hands, but if they are beaten by the majority, they may take comfort from the thought that this is the way in which every good nation is governed."

"The principle," he says, "supplying the necessary power, is actual and active co-operation with the work people, and a recognition of their rights in return for *such help as cannot be obtained from any other source.* There are two causes which have brought about the deplorable state of things among manufacturers to-day—imbecile under-selling and labor troubles. The system I advocate prevents labor troubles by preventing under-selling. The cure can come only from the power to control and the power can be gained only by an acknowledgment that the interests of employers and employed are one."

It is readily seen that in case of dull trade, or where foreign competition affects the market, employers and employed are able to co-operate understandingly to meet the conditions as they find them, and that the men may readily consent to a lowering of prices, and a consequent abatement of the bonuses paid to them; or even to lower wages if necessary, rather than be idle for a portion of the time and thus suffer loss in that way, and, of course, it is readily seen that such a condition might stimulate improvements, designed to lessen cost, and that both employer and employee would naturally favor and facilitate such improvement.

Mr. Smith enumerates the following conditions which result from the alliance:

1. The work people have a guarantee that existing wages shall never be reduced so long as the alliance lasts.

2. Wages for new articles introduced after its formation may be settled in each works, but either side can call upon the board to fix them.

3. The first bonus is also a fixture, as selling prices will not be reduced below the first level.

4. Any further bonus can only be paid on any increased actual profit. Any rise in selling prices caused by advance in the prices of material and not carried beyond, is exempt from further bonus.

5. All bonuses after the first are subject to a sliding scale whenever real profits are increased or decreased.

6. No strike or lockout is permitted unless in defence of the alliance. Then it is supported by both sides, and the expenses are divided.

7. In the event of any dispute to be referred to the board, workmen must accept employer's conditions and prices under protest. They cannot leave their employment or be discharged on account of this dispute, but the settlement must be retroactive so that no injustice may be done.

8. Each employer retains full control over his own works upon all matters but those pertaining to wages and bonus and conditions of labor. Workmen can be discharged for any other reason, and are themselves free to change their employment whenever they wish to do so.

9. The workmen's union must supply a sufficient number of good workpeople, and the board decides as to the necessity or otherwise of bringing new men into the trade.

10. No restriction is placed upon anyone wishing to come into the trade, so long as he agrees to sell on the lines laid down by the association, and to comply with the rules that govern competitors.

Furthermore:

a. It recognizes that unity is strength, whether among employers or employed.

b. It insists upon employers ascertaining beyond dispute the real cost of production before deciding upon the selling price, which must show a fair profit.

c. It acknowledges that if by organization employers are able to obtain a fair profit, it is their duty to pay their employees a fair wage, which they are compelled to pay.

d. It welds both sides into a compact body for the mutual purpose of insisting that all concerned shall have justice done to them, according to the agreement made, and that both shall work together with this object. All this is done by set rules and agreements, accepted on either hand after full consideration of all interests involved.

The plan recognizes that the consumer ought to be, and, indeed, must be, considered, and the case of the consumer is summed up by Mr. Smith in the article referred to as follows:

1. The consumer has never yet had the protection of a selling-price, based on the cost of production ascertained by the wisdom and experience of a whole trade. Under this system he is sure to get it.

2. Under a trust, or monopoly of any kind, capital alone decides what he shall pay. Under this system, the poorest class of consumer, the workman, has a voice in determining the price at which articles shall be sold to himself and others.

3. Should unjust selling-prices drive away trade, the bonus on wages paid to work-people will not compensate them for loss of time caused by slackness of trade. They will, therefore, not consent to unjust selling-prices, although these may bring them larger bonuses. Their consent is necessary under the terms of the alliance.

4. Under this system no restriction is placed upon anyone wishing to enter a trade, except that of not selling goods without the right proportion of profit on the cost of production. The result is that the consumer has no impediment in the way of making the goods for himself should he care to do so.

As we remarked in the article referred to above, it was said by one of our contemporaries, commenting upon Mr. Smith's article, that "it has been urged, too, that such a compact for mutual benefit between men and makers might prove a dangerous one to the industry and the country when the question arises of meeting competition of capital and labor warring merrily in other countries"; a criticism which seems to be founded upon the queer idea that capital and labor when warring with each other are more efficient and better prepared to meet competition than when they are harmonious and united upon a basis of mutual interest and confidence.

We think that all those who will carefully consider this resumé of the plan of organization, instituted by Mr. Smith, will agree that it is one which is at least worthy of very careful consideration by those who are vitally interested in the problem of securing a fair return for their labor and upon their capital invested in manufacturing enterprises. As we have said before, under ideal industrial and economic conditions no such elaborate plan of self-protection would be necessary, but we do not live under ideal industrial and economic conditions, many despair of ever obtaining them, and so long as the vast majority of men can manage to keep their heads above water only by the most strenuous and most unremitting efforts, and so long as economic and industrial conditions are such that some families are in danger of want or starvation, simply because men in another part of the world can produce desirable things cheaply; so long as industrial competition is referred to as "war," and the defeated are reduced to want or perhaps starvation, organizations of some kind will continue to seem imperatively needed, and if they are to continue to be formed, is it not best that they be made as thorough as possible and to include in them every element that can contribute to success? This Mr. Smith evidently endeavors to do, and the degree of success that has resulted thus far, entitles his plan to serious consideration.

Would it not be well for the National Association of Tool Builders to invite Mr. Smith to visit this country, or to send someone acquainted with industrial matters in America over to Birmingham to make a thorough and comprehensive study of the plan there instituted, and if possible in co-operation with Mr. Smith, so that

such features of the plan as seem adapted to the situation may be made use of here.

Probably most of our readers think they know what is meant by the term "four-step cone pulley," for instance; and yet it seems there is room for a difference of opinion regarding this. Some would say that a four-step cone pulley provides for four different speeds; whereas, others would say that it provides for five different speeds, these latter counting as steps only what the carpenter would call in a stairway the "risers." It seems that this latter interpretation is put upon the term by the publications of a well-known correspondence school. We do not believe, however, that this is the generally accepted understanding of the term; but think that among mechanics and users of cone pulleys it is practically universal to consider that a four-step cone pulley has four speeds, or faces, upon which the belt may run. This may not be strictly in accordance with the real meaning of the words used, but nevertheless it has come to be the commonly understood thing among those who have to do with cone pulleys, and who, of course, are interested in knowing, not how many steps an imaginary small man would have to take in traveling from one end of a cone pulley to the other but in how many different speeds the cone pulley provides for the machine it is intended to drive.

Penny international letter postage is again being discussed, and there is at least one reason why we strongly favor it, and that is that this will make foreign postage the same as domestic postage, and the apparently interminable trouble from underpaid foreign letters will, therefore, cease. We receive a great deal of underpaid foreign mail matter, on which we have to pay twice the amount of the deficiency, and in spite of all that we can do to prevent it, a good many letters leave this office for foreign correspondents which have two-cent stamps upon them instead of five-cent stamps, as they should have. This results from the fact that the youthful personage who attaches stamps late in the day, when it is nearly time to go home and the pile of letters looks large, cannot be induced to take sufficient pains to distinguish between domestic and foreign letters; at least we have never as yet devised a way of insuring that this will be done. Aside from this, however, any lowering of the barriers which prevent intercourse between the people of different nations is to be commended. The more letters there are written the better it is for both sides. It is by such means that the different peoples of the earth become acquainted—learn to know and to respect each other, and all such things make for civilization and the development of the human race.

New Tools and Machine Shop Appliances.

DUPLEX MILLING MACHINE.

A new duplex milling machine is shown in the two half-tone cuts. The driving power is supplied through gearing by a 25 horse-power variable-speed motor. The spindles are 6 inches in diameter, and have a full bearing in the saddle 29 inches long; they are driven by triple lead worm and worm-wheel of steep lead, the worm being case-hardened steel, and the worm-wheel is made of phosphor bronze. In addition to the variation in speed obtained through the motor, three additional changes of speed are obtained through the driving gearing shown in Fig. 2; this gearing is of the slip-gear design, and is controlled through a lever having three positions, which enables a change from one gear to the other to be readily made by the operator. This lever is back of the bed-plate at the point marked *X* in Fig. 2. The spindle saddles are counterweighted and are 27 inches long, and have a full bearing on the upright, the face of which is 22 inches wide, the uprights having an in-and-out adjustment on the wings. The carriage is 30 inches wide, 6½ inches thick, and is 11 feet long over all, to mill 10 feet in length; it has a full bearing on the ways of the machine, each 6¾ inches wide. It is operated by a helical pinion and rack, and has ten changes of geared feed running in geometrical progression from 54-100 inch on the slowest speed to 12 inches on the highest speed, per minute, with power quick traverse in either direction and hand adjustment. The automatic feed can be thrown out, the quick traverse operated, or table can be operated by hand from either side of the machine.

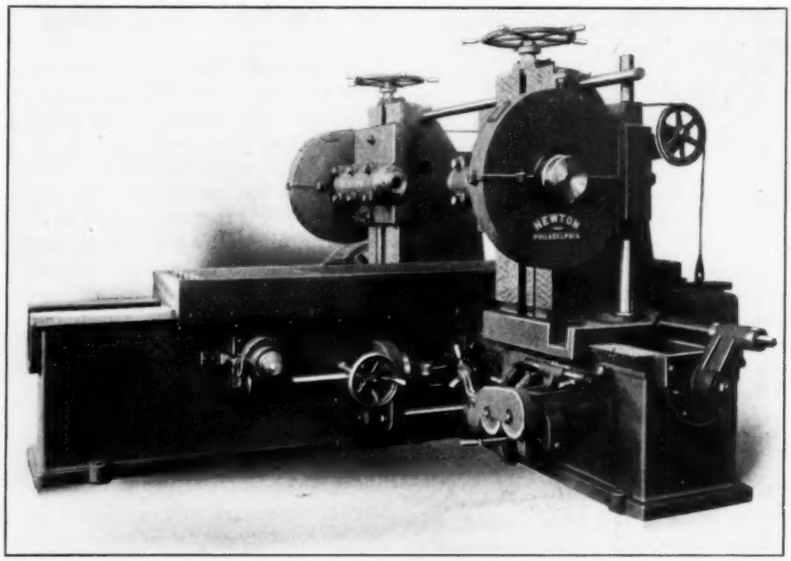


FIG. 1. DUPLEX MILLING MACHINE.

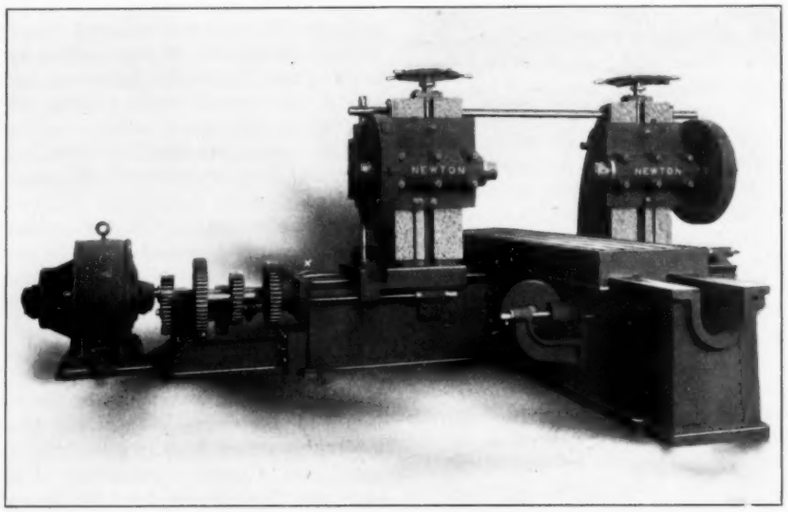


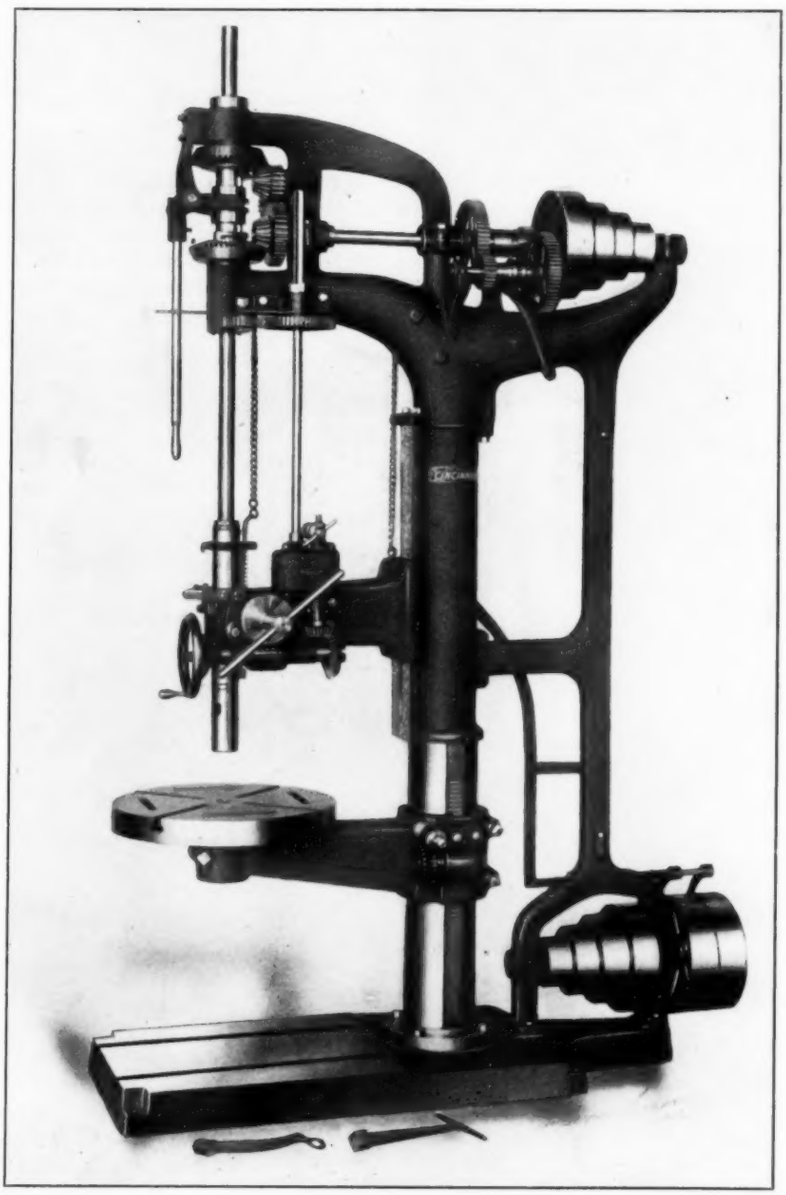
FIG. 2. DUPLEX MILLING MACHINE.

The maximum distance from center of spindle to carriage is 26½ inches, and the minimum distance from center of spindle to carriage is 5 inches; maximum distance between end of spindles 60 inches, minimum distance 18½ inches; maximum distance between uprights, 77 inches. Where desired, the machine is arranged with simultaneous adjustment so that both spindles may be adjusted vertically in parallel line. The approximate net weight of this machine is 43,000 pounds. It is built by the Newton Machine Tool Works, Philadelphia, Pa.

24—36-INCH DRILL PRESS.

The drill press shown herewith is one of a number recently built for certain work which is not very heavy, but is in rather large frames, so as to require plenty of room; and at the same time it was necessary, to insure quick manipulation and operation, that the machine be not too heavy. The working parts, therefore, are the same as those of a 24-inch drill press, while the base, table arm, head and top yoke have been lengthened out, so as to make a machine capable of swinging 36 inches, which has been designated by its makers as their "24—36-inch drill press."

The machine is equipped with a positive geared feed located directly on the head, which enables the feed per revolution to be instantly changed, the amount being clearly indexed. It has also a geared tapping attachment, though it can be furnished without this if desired. This device is located directly on the spindle and enables the spindle to be started, stopped or reversed and run back quickly by means of the lever shown projecting downward to the left of the spindle, without having to touch the belt-shifter lever. The Cincinnati Machine Tool Company is the builder of this drill press.

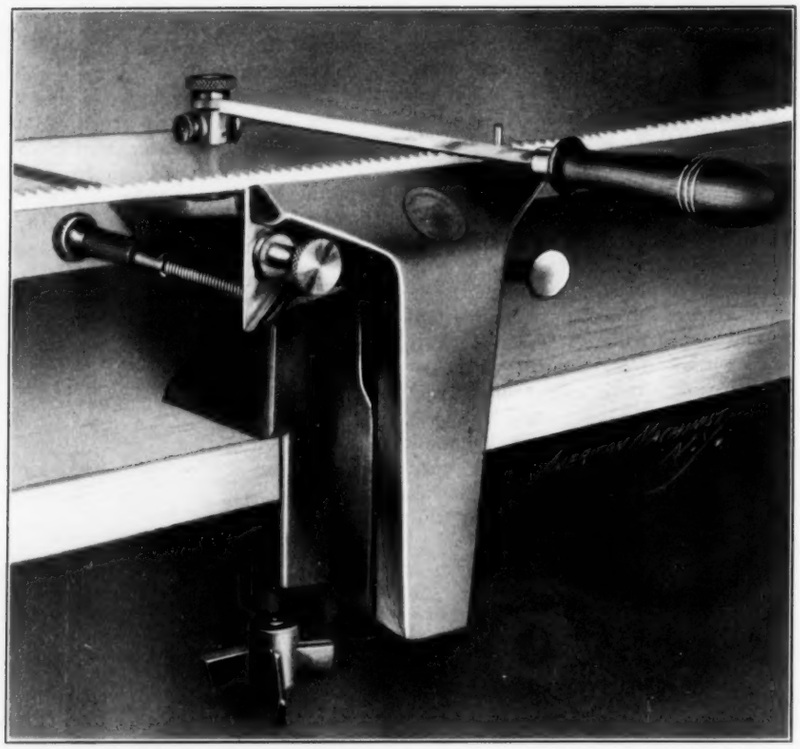


24—36-INCH DRILL PRESS.

VERTICAL FILE FOR DRAWINGS.

In this file the drawings are filed flat on edge in card or pasteboard folders which are placed in a large drawer. This drawer is hinged at its lower front edge, permitting it to be opened by simply tilting it forward. It is held in open position by an automatic catch, which is quickly released when desired to close the drawer. Each drawer is provided with an adjustable follower which moves back as the space fills up. When open, the drawer exposes its entire contents, and any drawing may be picked out instantly and again quickly filed. When a large tracing is to be filed, it is desirable first to pull out the folder to which it belongs, and after having placed therein the tracing, slip the folder back in its place. This prevents any accidental creasing of the drawing. The drawings may be filed alphabetically by title, or numerically. The latter method is the more satisfactory of the two. In filing the drawings numerically, each set of drawings is given a number and filed in a numbered folder. The title of the drawings and their numbers are entered on a card. These cards are filed alphabetically in a separate card-index cabinet. The drawing cabinets are made in three standard sizes adapted to accommodate drawings measuring 18x24, 24x36 and 36x48 inches, respectively. All filing sections measure 15½ inches in depth outside, and each drawer has a capacity of about 2,000 drawings, exclusive of folders. Each filing section is complete in itself, and, if desired, may be used without either top or base section. The cabinet shown consists of two filing sections, with top and base sections, which, of course, improve the appearance of the file. Sections of the

VERTICAL FILE FOR DRAWINGS.



BAND-SAW FILER.

same size will interlock vertically, and sections of any size may be interlocked horizontally when placed side by side. The C. J. Lundstrom Manufacturing Company, Little Falls, N. Y., is the maker.

BAND-SAW FILER.

The device illustrated herewith is designed to take advantage of and preserve the individuality of hand filing and yet make it as nearly mechanical as desirable. A vise is provided in which there is no clamping between every few teeth, the retention of the saw and insurance against chattering being automatic after the saw has once been dropped into place. The file feeds the saw along by pressing it from left to right; the hardened vise-jaws through the spring connections yield against such pressure and automatically tighten again when the feed has taken place. The file is guided, as shown, by anti-friction rolls on a level plate, which insure the teeth being filed always square across. These rolls are carried by a block clamped to the file, and any desired amount of hook to the teeth is attained and retained by locking the file against rotation in its holder. By filing from left to right with the saw in the position shown, the top of the tooth may be sharpened last, giving it entire keenness by throwing the burr forward. All saws but the heaviest may be laid in three coils on the bench back of the filer and fed through by the file, as noted above. The heaviest saws are best handled between wheels, so that no time is lost in shifting along. The filer clamps to any bench not over 2 inches in thickness, holds saws up to 1 inch in width and all thicknesses from No. 24 to No. 18 Stub's gage. A special round-corner file and the roller guide for the end of the file go with the device. The total weight of the apparatus is 14 pounds. It is made by the New Britain Machine Company, New Britain, Conn.

MACHINE FOR FINISHING CRANKS.

The illustration shows a machine for finishing cranks from the rough forging. The machine removes all the stock, it being unnecessary to drill and saw out the surplus metal between the webs.

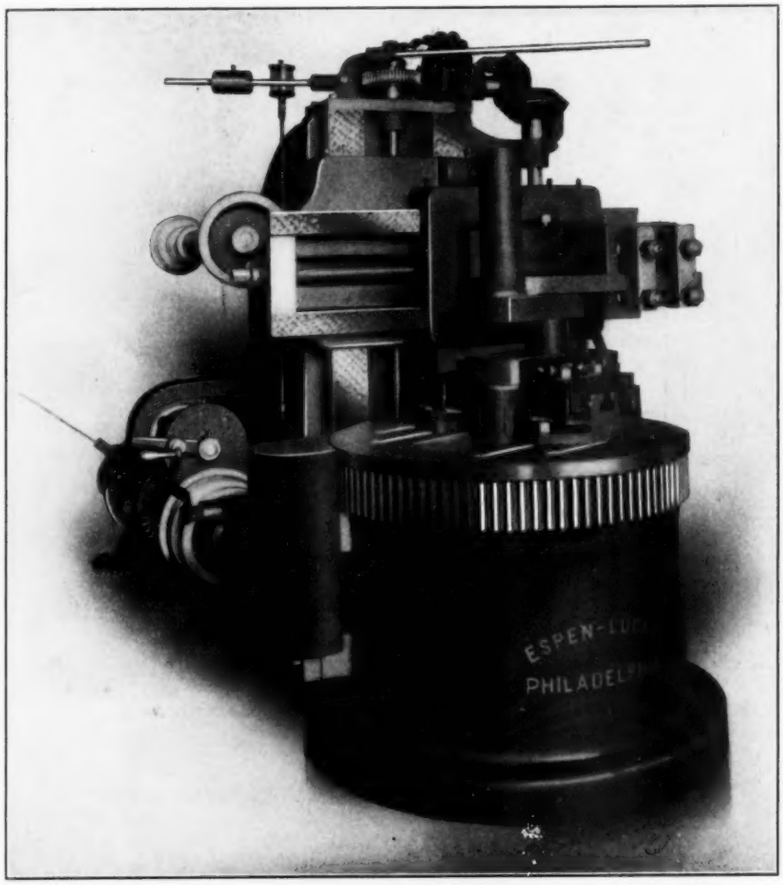
The table has a slot in it to accommodate one end of the crankshaft. Mounted upon the table is a vise in which the crankshaft is held as shown. A scale on the table facilitates the setting of the vise to correct position. The machine is capable of performing all the work on the crank, *i. e.*, roughing out the throw, turning off the ends and sides of the cheeks and facing the top and bottom.

The machine has automatic feeds in all directions. The one shown in the halftone will handle crankshafts up to 20 inches throw. The builders are the Espen-Lucas Machine Works, Broad and Noble streets, Philadelphia.

DISK GRINDER AND APPURTENANCES.

We illustrate herewith a disk grinder and accessories, the grinder being shown in Fig. 1, an improved lever feed table in Fig. 2, and a disk wheel press in Fig. 3.

The grinder shown is a No. 4 machine,



MACHINE FOR CRANKSHAFTS.

which carries thick disk wheels 20 inches in diameter, but it will swing 24 inches in diameter, if required. The end thrust, which is an important point in disk grinding, is taken from both directions at the right-hand box on hardened collars having 9 square inches area.

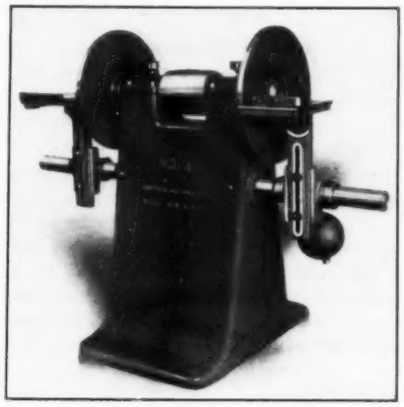


FIG. 1. DISK GRINDER.

The work tables can be set at any angle by graduations. The right-hand table swings across the face of the wheel around the rocker shaft, and is provided with an adjustable counterweight. Both tables are provided with adjustable gages. The gage on the left-hand table can be slid off, leaving the top of the table entirely plain and clear.

The rocker shaft is made extra long to allow the use of lever feed tables, as shown; and also to make room for solid cup wheels, or emery cylinders held in chucks, which may be used if desired.

Fig. 2 shows an improved lever feed

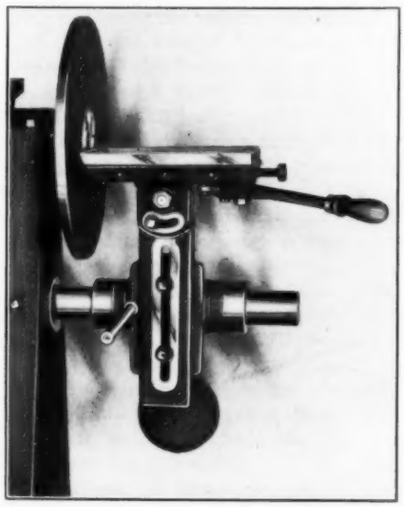


FIG. 2. IMPROVED LEVER FEED TABLE.

table, which is made either right- or left-hand and can be used at either or both ends of the No. 4 grinder instead of the regular tables. It is designed especially for heavy and rapid work, and by its use any allowable pressure of the work against the wheel can be obtained on all sizes and classes of work.

The table swings across the face of the wheel, on the rocker shaft. Its top is 9 inches wide by 14 inches long, and is mounted on a gibbed slide, which is perfectly protected from dust by sheet-metal shields securely fastened to the under side. It is provided with T-slots for ½-inch bolts. By means of the T-slots, holders for all kinds of work can be secured to the table in any position required. Graduations on the segment make it possible to set the top of the table at any angle from vertical to 45 degrees. The movement of the table is governed by a fine-threaded stop-screw at the back. The table is provided with an adjustable counterweight allowing a correct balance to be maintained.

This table is recommended for all manufacturing operations where more than a very few pieces of a kind are to be ground.

The disk-wheel press shown in Fig. 3 will take in wheels of 23 inches diameter or smaller. Pressure is obtained by the

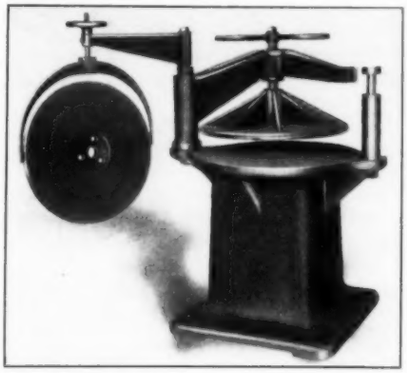


FIG. 3. IMPROVED DISK-WHEEL PRESS.

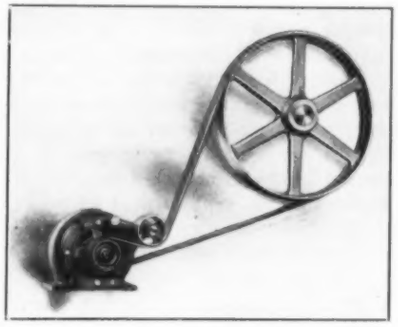
hand lever and differential screw. The thread in the arm is 3 per inch and in the plate 4 per inch. The arm and plate can be swung entirely clear of the base. By use of the lifting attachment shown, heavy wheels can be handled with ease, avoiding the risk and hard labor consequent upon lifting the wheels by hand. The lifting arms as shown can be used on only one size of wheels, but extra sets of arms with screw attached are furnished for any size of wheels required up to 23 inches diameter. One set of arms can be taken out and another size substituted in less than a minute.

The advantage of this press is that heavy wheels can be set up perfectly with little exertion, and there is no danger of disturbing the facing while it is damp. It is well for users of disk grinders to know that the setting-up or re-facing of disk wheels is a considerable item of the cost of operating disk grinders. If it is not well done it is worse than labor lost, as expensive circles are practically wasted.

The apparatus described in the foregoing is designed by F. N. Gardner, and is built by the Gardner Machine Company, of Beloit, Wis.

BELT-TIGHTENING IDLER FOR ELECTRIC MOTORS.

The accompanying illustration shows an automatic belt tightener, by which the arc of contact on the motor pulley may be largely increased in cases where the distance between the pulley centers is unduly short. A block which may be located in any one of four positions on the motor frame, carries the swivel arm for the



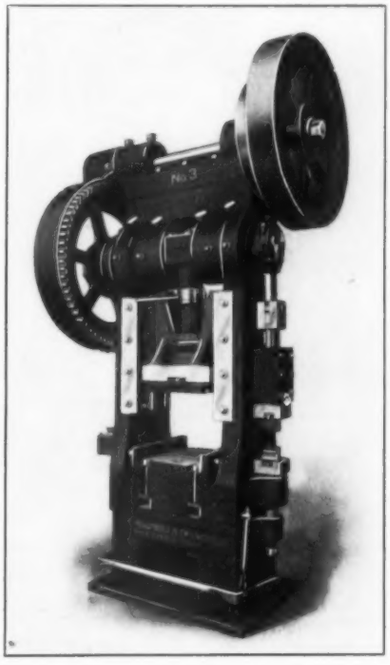
AUTOMATIC BELT-TIGHTENING IDLER.

pulley, the supporting stud for which may be inserted in either of two tapped holes in the block, giving eight possible positions to the pulley. An adjustable coil spring acts to tighten the nut.

The attachment is made by the Crocker-Wheeler Company, and may be applied to any of their form L motors having a rear end shield.

HEAVY GEARED TRIMMING PRESS.

The trimming press shown herewith is designed to meet the requirements of a



HEAVY GEARED TRIMMING PRESS.

drop-forging plant where very heavy work is done; it carries a special feature in the way of a side attachment, shown

in the picture, for cutting the forgings from the bar. The cutters are easily removed to allow of grinding. The frame of the machine is formed of practically three castings, the aggregate weight of which is about 12,000 pounds. The flywheel at the top, carried by the countershaft, weighs 2,000 pounds, and has a speed of 150 revolutions per minute. The pulleys on the countershaft are 24 inches in diameter. The ratio of the gearing is 5 to 1, giving a crank-shaft speed of 30 turns per minute. The diameter of this crank-shaft in its bearings is 5 inches, the bearings being 15 inches in length. The main ram has a standard stroke of 5 inches, and an adjustment of 5 inches, which is accomplished by means of a right-and-left-hand screw on the plunger. When the ram is at the top of its stroke and adjustment, it is 23 inches above the bed. The distance between the uprights is 27 inches, accommodating a bed for dies 22 inches square. The press covers a floor space over all of 48x68 inches, and weighs, complete, about 16,100 pounds; the maximum pressure which the main ram is capable of exerting is 700 tons. The press is built by the Billings & Spencer Company, of Hartford, Conn.

POWER PRESS WITH AUTOMATIC ATTACHMENT FOR FORMING BODIES.

The accompanying illustration shows a double-crank power press, arranged for cutting body blanks, and carrying them automatically to a set of forming rolls attached to the frame of the press, to be formed in cylindrical shape and discharged without extra handling. The same method can be used in connection with other presses, in accordance with the size of the work.

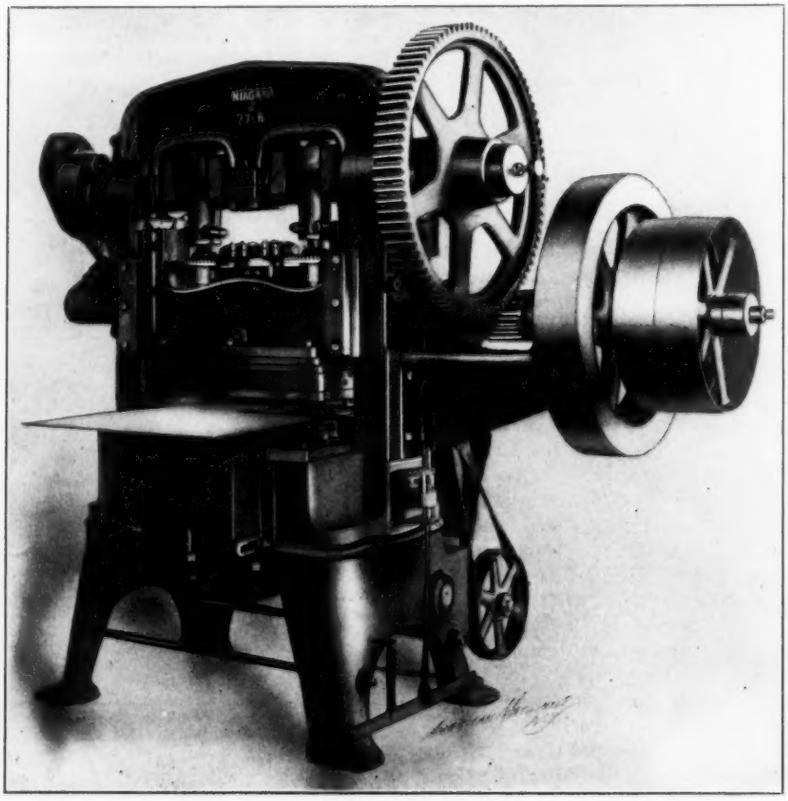
The press carries a cutting die for the body. There is a pad in the lower die onto which the body blank is clamped until the punch reaches the lowest position and the feed chains take hold of the blank to carry it toward the back of the press, where the blank drops onto a conveyor belt, which carries it into forming rolls. The body is formed into cylindrical shape, a stripping device being provided to prevent the material from forming around the rolls. The formed bodies can be made to drop into a chute.

The main shaft of the press carries two cams, one to clamp the material onto the die pad, and the other to actuate the feed chains by means of crank and pawl motion.

The motion of the press is controlled by a positive clutch. An electrically controlled tripping device for the clutch prevents the operator from starting the machine after each stroke until the material is in the proper position at the gages.

This press is made by the Niagara Machine & Tool Works, Buffalo, N. Y.

The Society of Naval Architects and Marine Engineers will hold its thirteenth general meeting in New York, at 10 A. M., Thursday, November 16. The meetings will be held in the auditorium of the American Society of Mechanical Engineers, at 12 West Thirty-first street. There will be a banquet at 7 P. M., Friday, November 17, to which members and their guests are invited. A list of very interesting papers will be presented at these meetings, and the sessions promise to be of unusual interest.



POWER PRESS WITH AUTOMATIC ATTACHMENT FOR FORMING BODIES.

New Publications.

"Der Eisenbau. Ein Handbuch fuer den Bruekenbauer und den Eisenkonstrukteur." By Luigi Viannello. 5½x8½ inches. 691 pages. 415 illustrations. R. Oldenbourg, Munich and Berlin. Price, 17.50 marks.

This is a hand-book of the size of a treatise. Its author sets out to supply the bridge builder and iron constructor with the formulas and working points that they need. In so doing, some preliminary knowledge of the subject is assumed. The book is not one for instruction, but rather for practical use. There is quite a little mathematics, but the higher is avoided. We cannot attempt here to outline the varied contents. It may be remarked that Gustav Schimpff supplies an appendix of tables of the I- and channel-section beams made by German rolling mills.

"Data Book of Steam Power Plants." By Chas. E. Lucke. 70 8x13-inch pages. Published by the author. New York. Price, $1.50.

This is a series of blanks intended for use in recording data obtained when inspecting power plants. Space is given to every element of a power plant, making it impossible to overlook anything of importance.

The October number of *Social Service*, which is published by the American Institute of Social Service, 287 Fourth avenue, New York, is devoted to an exposition of the things shown in the American section of social economy at the Liège International Exposition, held during the present year. Descriptions are given of the exhibits themselves, and there are extracts from newspaper comments, lists of awards, and altogether a great deal of information which ought to be of interest to those who own, operate, or work in, industrial establishments.

We have received the initial number of *Wood Craft*, a new journal which, however, has absorbed the paper formerly known as *The Patternmaker*. As indicated by its new name, the new journal has widened its field somewhat, and now aims to cover all the arts of woodworking of the finer and better sorts. R. I. Clegg, well known as an acceptable contributor to our columns, is its editor, and it is published by the Gardner Publishing Company, Caxton Building, Cleveland, Ohio, of which company G. H. Gardner, for many years connected with the *Iron Trade Review*, is president and treasurer. Little

more need be said to show that the new journal is likely to be conducted upon a high plane and to be successful. The initial number contains a long list of very interesting articles, which are well written, edited and illustrated.

An English Precision Lathe.

The difficulties which have been encountered in the production of interchangeable screws of guns, gun mountings, etc., made, as they are, in different shops, led to the appointment of a committee by the British government in 1900 to consider the subject. This committee has recently rendered its report, which contains a description of a novel screw-cutting lathe of the highest attainable precision, which is the result of the work of the committee, and this description, with the accompanying illustrations, we reprint below. The machine is to be deposited at the National Physical Laboratory, where it will be placed in a specially prepared room having double walls and every possible provision for maintaining a constant temperature. It is to be available for cutting precision lead screws for general purposes as well as for the British Army and Navy. Following is the description of the machine:

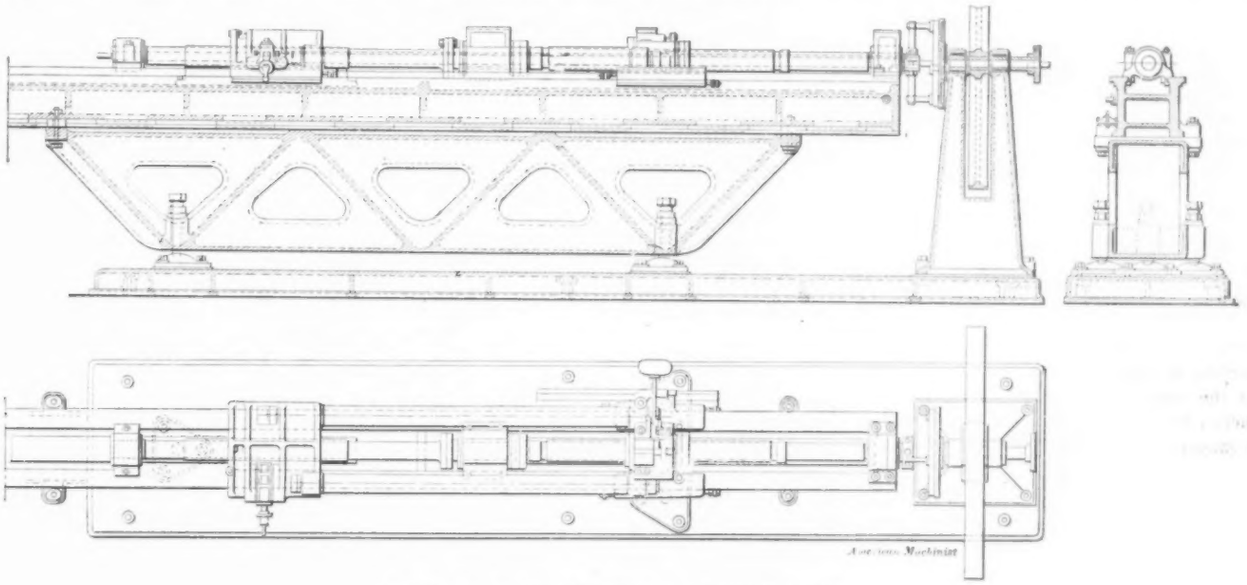


FIG. 1. PLAN AND ELEVATION OF PRECISION LATHE.

In considering the action that should be taken, your committee had first to consider what standard of accuracy should be aimed at in the master screw which was to be commercially reproduced, and on the evidence before them decided that an error of not more than 0.0001 inch per 12 inches of length of screw was allowable. It is satisfactory to note that this error was ultimately materially improved upon.

The general question of the accuracy obtainable under workshop conditions with ordinary standardized end-measure gages, was also, from the beginning of their deliberations, forced upon your committee's notice, and useful results have followed the incidental verification of the fact, that end-measured gages, even under favorable conditions, are not usually as accurate as could be desired. This appears to be largely because high-class engineering workshop practice has advanced very rapidly in accuracy during recent years.

It requires to be noted that for purposes of accurate reproduction of interchangeable parts the laboratory verification requires to be as much superior to the gage-room work as the gage-room work requires to be ahead of the works. The importance of this question will undoubtedly have to be officially recognized, and additional and improved facilities for the accurate verification of gages provided in the future.

Practically it has appeared to your committee that in individual end-measure comparisons 0.001 inch in 12 inches being the accuracy commonly obtainable in the general workshop, requires an accuracy of 0.0001 inch in 12 inches in the gage-room, and 0.00002 inch in the laboratory verification.

There appears to be greater probability that the workshop limits of accuracy may become finer than that greater accuracy should become possible in the gage-making workshops and verification laboratories; and in the meantime, what appears to be commonly required is rather greater care in the use of existing facilities than actually new facilities.

The foregoing limits of accuracy may appear small, but the work done for the committee shows that they present no excessive difficulties when proper precautions are taken.

Messrs. Humpage, Jacques and Pedersen, who had gone closely into the production of some very accurate screws, particularly emphasized the fact that, apart from the difficulty of making an accurate screw of great length, a short screw will in use be the most satisfactory, as over 90 per cent. of the work in an ordinary machine shop can be done on a screw 1 foot long, if in the form of a sleeve and capable of being set at any point along the length of the bed of the lathe; and as no such irregularities can occur with such a screw as commonly result from the local wear of a long screw, most of the wear upon which falls within a very limited portion of its length.

Your committee, while not prepared to take such an extreme view, believe that all reasonable requirements are likely to be met if extreme accuracy can be obtained over 3 feet length of screw. The machine was accordingly designed upon this basis.

The pitch of the screw upon which it was decided to work was fixed at ½ inch, as the most generally useful in the medium heavy lathes doing work of the class most prominently before your committee. And it was decided that screws of other pitches should be left to be generated as required locally, and the necessity for gearing, with its accompanying unavoidable errors, thereby avoided in the adjusting machine.

The diameter of the screw was fixed at 4½ inches as giving substantial bearing surfaces, thus allowing the screw to be made hollow, and combine lightness with rigidity, as well as permit of water cooling internally, if found desirable.

Although it was never proposed to do more than take a final correcting cut on a screw already approximately true, it appeared desirable to ascertain definitely whether the force exercised in cutting would have any appreciable deforming effect upon the screw. For this purpose a diagram was prepared by Colonel Holden

showing the pressure upon the tool when taking light finishing cuts, as ascertained from the indications of a spring transmitting the torque of the lathe face-plate to the work. From this information, Dr. Chree calculated on various assumptions for Dr. Glazebrook the possible deflections of the screw that might result, and showed that the strain effects on a screw 4½ inches diameter were absolutely negligible, the greatest effect with a cut of 0.001 inch to be anticipated being five parts in one million in the length of the screw.

The design and details of the machine were worked out by Mr. Matthews, in collaboration with the committee, and its general arrangement is shown in the illustrations, the following being its main characteristics:

The bed upon which the tool carriage, etc., slide is very stiff, of a form very little liable to deformation through variations of temperature, and is mounted on a deep girder, supported at three points upon a shallow continuous foundation plate.

The driving headstock is supported upon the foundation plate entirely separate from the bed of the lathe, and drives by means of a Clement's driver the master screw, which is mounted in long bearings on the bed of the machine, and is coupled direct to the screw which it is desired to correct, the two screws being thus coaxial. The screws are also stiffened against deflection by sliding supports.

The master screw is 4½ inches diameter, with a square thread ½ pitch and section of thread ¼x¼ inch in the plane of the axis of the screw. The nut is 14 inches long, embracing 28 threads, and is arranged for a maximum traverse of 3 feet. The thread of the nut is of bronze, and was cut by being turned 5 inches diameter outside on the exterior of a bronze core 4 inches diameter, which was then enclosed in a steel sleeve of similar steel to that used for the screw, and therefore having the same co-efficient of expansion, after which the core was bored out; it being considered that greater accuracy could be obtained by this means than by directly cutting an internal thread.

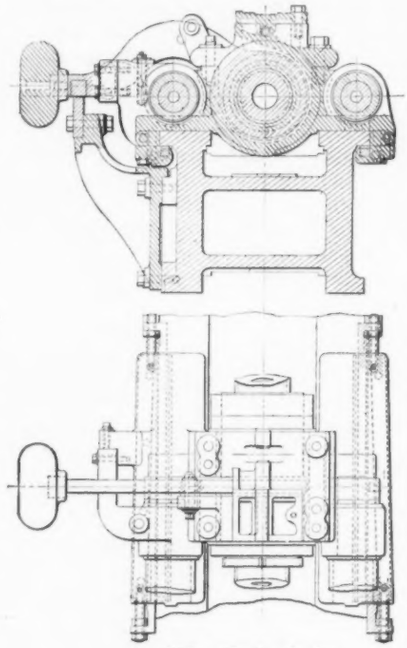


FIG. 2 The Nut Carriage

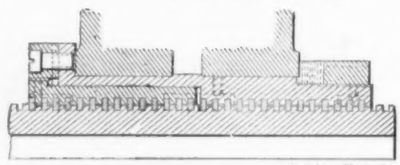


FIG 3 Enlarged Section of Nut

The sleeve of the nut is rigidly connected to a stiff arm projecting horizontally to the back of the lathe, and weighted at its end so as to bear upon the stationary correcting bar, which serves to advance or retard the motion of the nut as it is traversed along the master screw. A variation of 0.16 inch in height of the correcting bar corresponds to 0.001 inch of motion of the nut.

The nut is divided at its center transversely, so that all end-play can be taken up, one-half being arranged to bear against the back, and the other against the front of the thread, so as to accurately control the motion of the heavy cross-head sliding on the bed of the lathe. Two strong steel hollow rods bolted to this cross-head, one on either side, transmit the longitudinal motion of the nut to the saddle carrying the cutting tool, which is thus traversed along the screw to be corrected, which, as already described, is rigidly connected to the master screw.

The tool is carried on a cross slide, and as the weight of evidence indicated that chatter was more readily avoided by so doing, the cutting edge of the tool was arranged to be on its lower side.

A bar is arranged to be fixed upon transverse bridges on the bed of the lathe, so as to be directly over either the master screw or the screw being cut. The sliding carriage upon this bar was designed to be connected either to the saddle moved by the master screw, or can be moved by a feeler lying in the threads of the derived screw, so that the regularity of either can be observed. The observations can be made both by means of a microscope traversed by the overhead slide over a scale resting on the fixed bar, and by means of end-measure gages lying between an abutment on the moving slide and a micrometer head attached to the fixed bar. The microscope and micrometer abutment for use with end-measure gages are also fitted to the saddle carrying the tool, thus allowing of direct observations of the motion of the cutting tool.

From such observations any required correcting bar can be laid out, so as to give the cutting tool regular motion, in spite of slight irregularities of the master

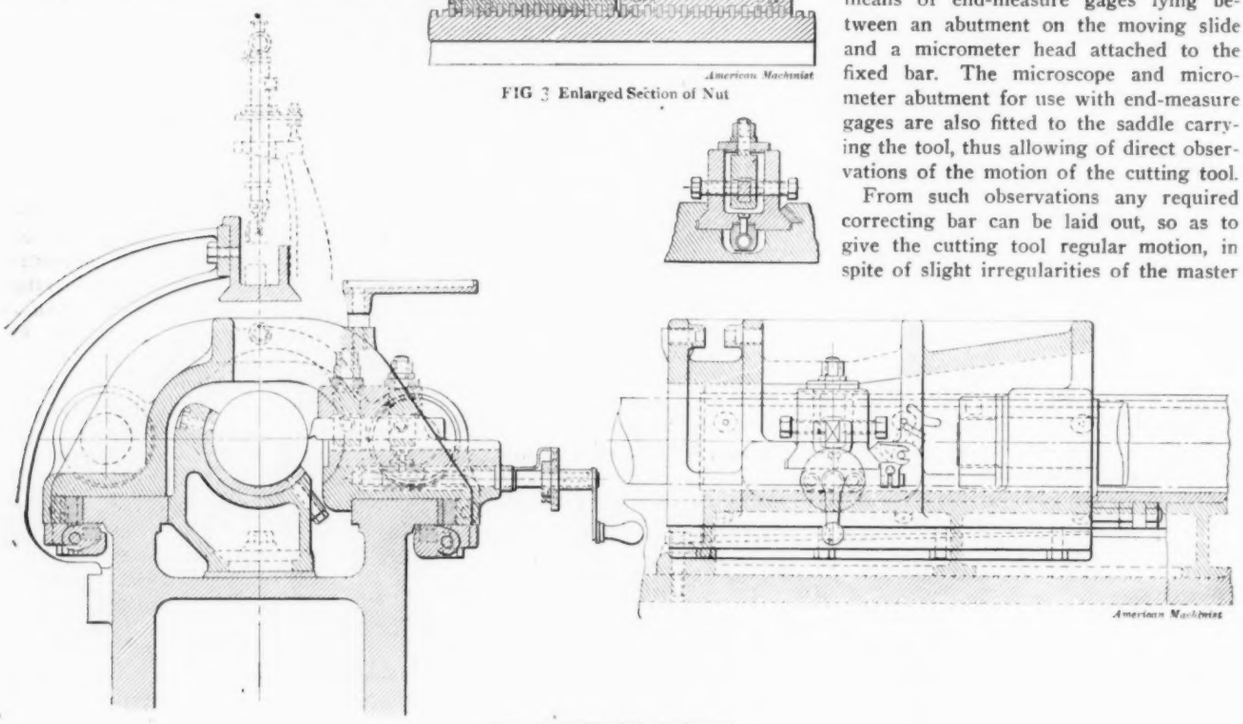


FIG. 4. THE TOOL CARRIAGE.

screw. The screws and the rods connecting the saddle and cross-head are made hollow, so that water can be circulated through them if thought desirable. All the slides of the machine are made with ample bearing surfaces and with packing pieces for taking up slack. Provision is also made for clamping the cutting tool slide.

The two scales provided for use with the machine are engraved upon iridio-platinum strips inlaid in the trough of H section bars, which were made of similar steel to that used for the master screw, in order to minimize errors due to different co-efficients of expansion. They are 40 inches long, and divided into tenths of an inch; one is standard at 0 degree Cent., the other at 62 degrees Fahr., the temperature at which the screw-adjusting machine is designed to work.

Neither of the special scales procured for the machine were available for use at Manchester during the preliminary experiments in the manufacture of the first screws, and existing standard scales were not found convenient for use; also unexpected difficulties arose, owing to various causes, in obtaining indisputable cross checking between the end-measure gages available for reference. Messrs. Armstrong, Whitworth & Co., therefore, worked under considerable disadvantage in making the final adjustments on the machine, the more so as the overhead slide designed to carry the microscope, etc., was found to be not quite satisfactory in the final measurements, so that all measurements had to be made against end-measure gages supported on the bed of the machine.

It is therefore very satisfactory that measurements made after delivery of the machine at the National Physical Laboratory, when placed in the special chamber erected for it, showed that the movement of the tool carriage did not vary from that produced by a true screw of the same reputed length by more than 0.0002 inch in its full length, and after the insertion of a correcting cam by more than 0.0001 inch at any one point, and that corrected microscopic scale readings and independent end-measure readings did not differ by more than 0.0001 at any point.

The progressively increasing difficulty of each step in advance in respect of accuracy, and the precautions—not usual in engineering workshops—that consequently require to be taken, were strongly emphasized in the course of the work done for the committee at Manchester, as well as by the difficulties found at Woolwich in the course of the measurements made on the lathe supplied by Messrs. Muir to the Royal Carriage Department; and it became evident that, to make the best use of the machine, it was necessary to erect it where disturbances by vibration and variations of temperature would be minimized.

With the co-operation of the Committee of the National Physical Laboratory, provisional arrangements were made to install it there, and your approval was sought and obtained for funds to house it, and every provision was made to meet any possible future demands on the machine.

With its October issue the Rand Drill Company announces that the publication of its house organ, *Air Power,* will be discontinued. The publication has been a useful one, and it will be missed by those interested in the applications of compressed air.

Some of the wise things that men have said seem so simple that a fellow actually gets mad to think that he didn't think of them himself. Some successful inventions that men have made affect one just the same way.

Personal.

Arthur Warren has resigned his position as manager of publicity for Allis-Chalmers Company, Milwaukee, Wis., and will sail for Europe about the end of November on a journalistic mission.

Business Items.

The General Electric Company, Schenectady, N. Y., received a gold medal for the best exhibit in the Electrical Department at the Lewis and Clark Exposition, at Portland, Ore. It also received gold medals for various special features of its exhibit.

The Bury Compressor Company, of Erie, Pa., will have one of its air compressors on exhibition at the Paris Automobile Show, which takes place early in December. This machine will furnish air to operate the numerous American appliances sold in Europe by Fenwick Freres & Co.

The E. F. Reece Company, Greenfield, Mass., manufacturer of screw plates, taps and dies, owing to its increasing business, has found it necessary to increase its facilities, and is now building a stone and cement fireproof building, 40x50 feet, two stories, which it expects to have completed and equipped in six weeks or two months.

The American Blower Company's shops at Detroit are extremely busy in all departments. Among other large orders is one for complete heating apparatus for the new Allegheny shops of the Pennsylvania lines west of Pittsburg. This company has also received the contracts for the heating and ventilating of the new Altman building in New York and the Marshall Field building in Chicago.

Worcester Steel Foundry Company, Worcester, Mass., has been reorganized and incorporated with a larger capital. Its general offices will be in the Central Exchange Building, Worcester, Mass., where all correspondence should be addressed, but its foundry and works are located at Millbury, Mass. The officers of the new company are J. O. Emanuel Trotz, president; William E. Oakley, vice-president; William H. Cook, treasurer, and William Pestell, general manager. The company will manufacture electric rail bonds and castings of steel, brass and all alloys.

Plans are being prepared and building operations will commence at once on a four-story (with full basement) brick and steel factory addition to the plant of the National-Acme Manufacturing Company, Cleveland, O. The building will be in readiness for occupancy early in 1906. The four-story addition built during the past summer afforded only slight and temporary relief to the crowded condition of all departments, and the present capacity will be more than doubled when the improvements under way have been carried out. This company maintains branch offices in New York, Boston and Chicago, and is represented in Europe by Messrs. Schuchardt & Schutte and Alfred H. Schutte.

Manufacturers.

The plant of the Newark (N. J.) Door Company was destroyed by fire.

The town of Sparta, Ga., is planning to instal an electric light system.

The Bon Ami Company, Manchester, Conn., will put up a new spar grinding mill.

The Athol (Mass.) Silk Mills were damaged by fire to the extent of $25,000.

The Danville & Western Railroad is rebuilding its burned shops at Danville, Va.

The Taylor Signal Company, Buffalo, N. Y., is building several additions to its plant.

The Rockford (Ill.) Well Drill Company is erecting a new foundry and pattern shop.

The Security & Metal Works Company, Portland, Ore., will erect a new $25,000 factory.

The plant of the Dunbar (Pa.) Sand Manufacturing Company was burned; loss, $10,000.

The United Oilcloth Company, Yardville, N. J., will put up two new factory buildings.

The plant of the Enterprise Mantel Company, Pittsburg, Pa., was burned; loss, $10,000.

The Continental Motor Company, Muskegon, Mich., is putting up a factory, to cost $10,000.

The Lawrence (Mass.) Gas Company is to make an enlargement of its electric power plant.

The Ohio Pattern Works Company, Cincinnati, O., has taken a permit to build a new factory.

The Talbot Ice Company, Omaha, Neb., will expend $50,000 for a new building and machinery.

George W. Prentiss & Co., wire manufacturers, Holyoke, Mass., are to add a new mill.

The Brooklyn (N. Y.) Range Boiler Company will erect a new factory in Long Island City.

The Structural Tubing Company, Danville, Pa., is building an annex to its finishing department.

The Illinois Malleable Iron Works, Chicago, Ill., have let contracts for a $75,000 warehouse.

The Richmond (Va.) Drop Forge Company has awarded contract for the erection of a new building.

The Baltimore & Ohio Railroad will soon begin to rebuild its burned shops at Parkersburg, W. Va.

The Standard Lime & Stone Company, Fond du Lac, Wis., will establish another plant at Oakfield, Wis.

The Northwestern Peat Fuel Company, of Minneapolis, Minn., will instal a plant near Norwood, Minn.

S. P. Stevenson & Co., lumbermen, Chester, Pa., have awarded contract for the erection of a $20,000 plant.

Motto & Son, upholsterers, Goshen, Ind., are erecting a new factory, to be equipped with a steam plant.

The Stanley Works, New Britain, Conn., manufacturing builders' hardware, will erect a new machine shop.

The National Reed Company will erect a factory building, together with a boiler-house, at Manchester, N. H.

The Crompton-Knowles Loom Company, Worcester, Mass., will put up a five-story addition, to cost $40,000.

The Baltimore (Md.) Pearl Hominy Com-

pany will erect a new plant, which will include a new power-house.

The American Graphophone Company, Bridgeport, Conn., is having plans prepared for an additional building.

The Nudd & Taylor Company, manufacturer of eaves and gutters, will move its plant from Centralia, Wash., to Seattle.

The Post & Sheldon Corporation, of Paterson, N. J., will erect a three-story addition to its silk mill at Slatington, Pa.

The Ellendale (Minn.) Milling & Light Company, with Frank Kycek as president and treasurer, has been organized.

A new plant is to be constructed at Appleton, Wis., by the Appleton Bearing Metal & Chemical Compound Company.

The Glencoe (Minn.) Foundry & Machine Company is building an addition, which will be utilized as a molding room.

The Pitman-Myers Company, manufacturing chemists, Indianapolis, Ind., will erect a four-story laboratory and factory.

M. G. Sperry, C. F. Teter, of Philippi, W. Va., and others, are about to organize, build and operate a large carbon works.

Adam Beach, whose sawmill and electric light plant at Arlington, Ohio, were destroyed by fire, will rebuild both factories.

The Taunton (Mass.) Knitting Company has been incorporated with a capital of $50,000. C. L. Macomber, Taunton, president.

The Philadelphia Glazed Kid Company, Camden, N. J., has acquired another building and will instal $20,000 worth of machinery.

Two buildings of the Rogers & Schwartz evaporating plant, at Salem, Ill., were destroyed by fire. They will be rebuilt at once.

The Empress Glass Company was organized at Grafton, W. Va., with a capital of $50,000. George M. Whitescarver, president.

The Plume & Atwood Manufacturing Company, of Waterbury, Conn., maker of brass and copper goods, will erect an addition to its plant.

The Vermont Marble Company, of Proctor, Vt., is about to begin the construction of a new warehouse and factory at its Chicago plant.

John W. Clinard, manager of the Hight Point (N. C.) Veneering Company, is the promoter of another factory to manufacture oak veneer.

The National Steel & Wire Company, of New Haven, Conn., and other cities, will, it is said, locate a $2,000,000 plant in Los Angeles, Cal.

The New Haven (Conn.) Silver Company has been incorporated with a capital of $200,000. Max Strouse, H. C. Bretzfelder and others incorporators.

M. J. Drummond & Co., controlling the Glamorgan Iron & Pipe Company, Lynchburg, Va., has bought a site for a new plant, to cost about $1,000,000.

A plant has been secured by the Automatic Adjustable Wrench Company in Rock Island, Ill., which will be equipped with machinery for manufacturing its wrench.

An extensive addition is to be made to the plant of the Newburg (N. Y.) Ice Machine & Engine Company. The new building will be used for the manufacture of heaters.

The Menominee (Mich.) & Marinette Paper Company has decided to rebuild one of its mills, which was destroyed by fire a short time ago. The new mill will cost $175,000.

The McMyler Manufacturing Company, Warren, O., builders of hoisting and dock machinery, etc., on account of increased business, proposes to double the capacity of its plant.

Brown & Lowe, Schenectady, N. Y., have been awarded contract for the construction of the People's Match Company's plant at Homelands. The company is capitalized at $100,000.

The Hedington-Pfeil Furniture Company, recently incorporated at Baltimore, Md., has secured a site and will erect a factory, also boiler- and engine-houses and dry kiln. Wm. Hedington is president and general manager.

The Burgess-Norton Manufacturing Company, to make machinery and hardware specialties, has been incorporated, and is erecting a plant in Geneva, Ill. Fred. A. Burgess and H. W. Norton, of Aurora, Ill., are incorporators.

The Kent Light Company, of Patchogue, N. Y., has been incorporated with a capital of $250,000. The company will manufacture gaslight and electric light fixtures, etc. F. M. Choate, F. H. Fairchild, of East Orange, N. J., are directors.

New Catalogs.

Jeffrey Manufacturing Company, Columbus, O. Bulletin No. 10, describing electric mine locomotives. Illustrated. 8x10, pp. 68, paper.

Warren Webster & Co., Camden, N. J. Part V, Appendix IV, to General Catalogue, illustrating and describing the Webster waterseal motor.

Tindel-Morris Company, The Bourse, Philadelphia, Pa. Mailing card illustrating and describing the Tindel-Albrecht crankshaft finishing lathe.

United Engineering & Foundry Company, Pittsburg, Pa. Circular illustrating and describing pipe crushing and shearing machine for use in tube mills, steel plants and scrap yards.

National Battery Company, Buffalo, N. Y. Bulletins and circulars illustrating and describing electric storage batteries for street railways, automobiles, central power and lighting stations, etc.

Coburn Trolley Track Manufacturing Company, Holyoke, Mass. Catalogue entitled "The Benevolent Giant," which describes the Coburn trolley track carrier system. Illustrated. 6x9, pp. 8, paper.

The Wellman-Seaver-Morgan Company, Cleveland, O. "Iron and Steel Works Equipment Catalogue, Section 'E.' Cranes." This describes ladle, overhead traveling, gantry and locomotive cranes. Illustrated. 9x12, pp. 112, paper.

Coates Clipper Manufacturing Company, Worcester, Mass. "Flexible Transmission." Bulletin No. 19, showing Coates flexible shaft adapted to various services, such as drive for drills, center grinders, etc. Illustrated. 6x8½, pp. 20, paper.

Locke Regulator Company, Salem, Mass. Catalogue entitled "The Locke Automatic Engine Stop and Speed Limit System," which describes the automatic safety appliances for steam and electric motors, manufactured by this company. Illustrated. 6x9, pp. 32, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Special publication No. 7038, "Westinghouse Rotary Converters," giving their characteristics and construction, with instructions for their erection, operation and care. Illustrated. 6x9, pp. 67, paper.

General Electric Company, Schenectady, N. Y. Bulletin No. 1049, describing railway line material and rail bonds. Illustrated. 8x10½, pp. 84, paper. Pamphlet containing test of a 2,000-kilowatt Curtis steam turbine. Circular No. 3367, illustrating and describing luminous electric radiator. Flyer No. 2166, describing porcelain receptacle for molding wiring. Supply Catalogue No. 7591, parts of edgewise parallel rod, 110-volt, direct-current, multiple enclosed arc lamp, forms 14 and 12. Pamphlet entitled "Mercury Arc Rectifiers," which is a reprint of a paper by P. D. Wagoner, read before the National Electric Light Association.

The Emerson Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 3106 (replacing Bulletin No. 3062), illustrating and describing single-phase induction motors, Class 32 DA, 1-10 to 1-6 horse-power. Bulletin No. 3201 (replacing No. 3043), illustrating and describing bipolar enclosed motors for direct current Class 412 to 422, 1-20 ⅛ to 1-3 horse-power. Bulletin No. 3202 (replacing No. 3060), bipolar enclosed motors for direct current Class 412 to 422, 1-20 to 1-6 horse-power. Bulletin No. 3301 (replacing Nos. 3051-3055), electric forge blowers, direct connected for direct and alternating currents. Bulletin No. 3302 (replacing Nos. 3051-3055), electric volume blowers for direct and alternating currents. Bulletin No. 3701 (replacing No. 3053), laboratory lathes for alternating current. Booklet No. 4120, entitled "Motors in Small Sizes," giving in condensed form the different types of motors.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad st., New York.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed; working drawings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Agency for N. Y. city wanted for meritorious articles for steam users and metal trades; must be first class. "J. C. S.," care AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted to Purchase—One gear cutter that will cut a gear wheel 71 in. in diameter, 10 in. face, 2¼ in. circular pitch or smaller; a second-hand machine in good order would be considered. Write the Ottumwa Iron Works, Ottumwa, Iowa.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

For Sale.

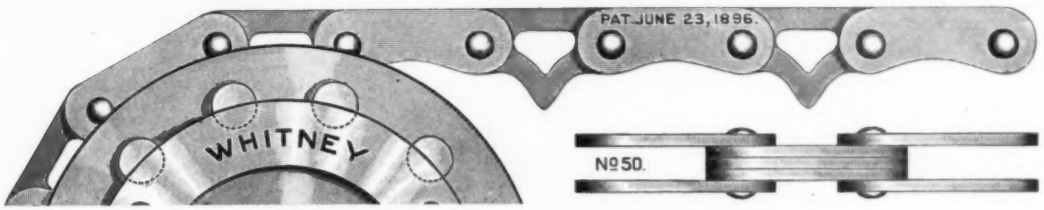
For Sale—A full line of mine and boiler feed pump drawings; a good specialty; latest and best designs. Box 757, AMER. MACH.

For Sale by the Inventor—U. S. patent No. 786,824; will consider partnership proposition with services included. Address "R. C. L.," care AMERICAN MACHINIST.

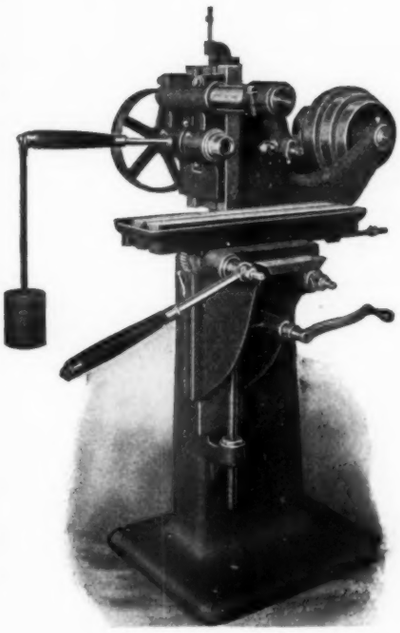
Business Opportunities.

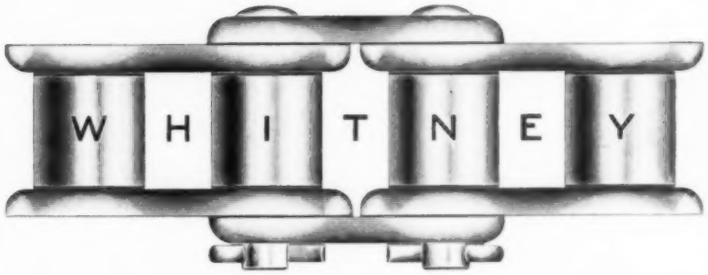
A prosperous foundry and machine works in Atlanta, Ga., desires to arrange with manufacturers or patentees for the right to manufacture staple articles of steel and iron suitable for sale in the South. Box 787, AM. M.

I want a tool and die maker with money and good specialties, or even good ideas, to join me in manufacturing. I have both cash

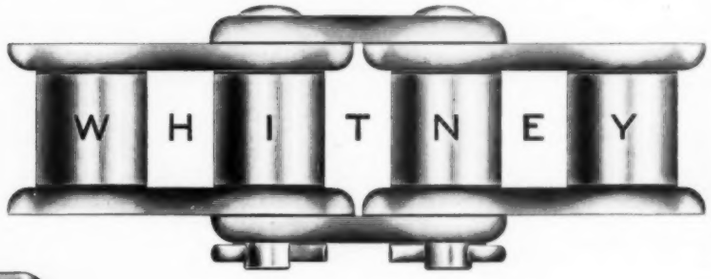


"WIZARD" Chains and Sprockets—Patented

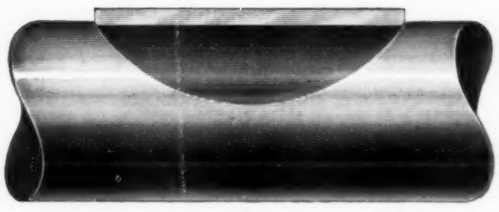




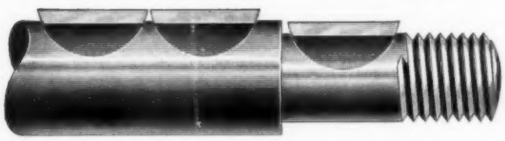
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal.

and specialties, and can market the product. "B. F. B.," 1020 Westinghouse Bldg., Pittsburg, Pa.

Reputable, well-known, old-established and fully equipped patternmaking plant, in fine condition; thoroughly organized; large and prominent clientage; located in New York city, and earning handsome profit; stand strict investigation, exceptional opportunity; references exchanged. Box 786, AMER. MACH.

Wanted—A man of good business and executive ability and some capital, to take the management of a business requiring the introduction and putting on the market of a new invention of undoubted merit and a large field of trade; it has been sufficiently introduced to prove it to be a success and a money-maker; have plant complete to manufacture. Box 750, AMERICAN MACHINIST

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Am considered a first-class mechanic; 9 years as superintendent and master mechanic of a large plant; experienced on small and large tools, press work, dies, automatic machinery, plating, etc; reference. Box 773,, AMERICAN MACHINIST.

FOREIGN.

Gentleman, established in Belgium, visiting New York, well introduced in Belgium, France, Germany, wishes to represent American tool manufacturer. Box 775, AMER. MACHINIST.

ILLINOIS.

Wanted—Position as foreman of screw-machine department; 14 years' experience; reference. Address Box 780, AMER. MACHINIST.

A No. 1 machinist, 28, wishes position as foreman in a small shop in Chicago or vicinity; 13 years' experience on automatic machines, tools and dies; is good designer; experimental work preferred. Box 781, AM. M.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs Box 713, A. M.

NEW JERSEY.

Position wanted by draftsman, 35, with 18 years' experience in general designing. Box 778, AMERICAN MACHINIST.

NEW YORK.

Competent mechanical draftsman wants position; New York or vicinity. Box 774, A. M.

Mechanical draftsman, graduate, with several years' experience, open for engagement. Box 751, AMERICAN MACHINIST.

Mechanical superintendent, good executive manager, etc., open for engagement; references. Box 770, AMERICAN MACHINIST.

Young technical college graduate desires position; experience with electric lighting company and in mechanical drafting work. Box 776, AMERICAN MACHINIST.

First-class mechanical draftsman wants to change position; long experience on Corliss engines and gas motors; New York or vicinity preferred. Box 783, AMERICAN MACHINIST.

Working foreman; position by A1 diemaker and machinist; sub-press, open or combination dies; is systematic and a hustler; 38; for city or surrounding. Box 782, AM. M.

Competent, middle-aged draftsman, experienced in locomotives, automatic and general machinery, is open for engagement; New York or vicinity preferred. Box 772, AM M.

Wanted—Position as works manager or superintendent of machine tool or engine work; several years' up-to-date experience; location immaterial. Answer Box 745, AM. M.

Manager and superintendent of factory; now open for engagement; familiar with modern office, shop and foundry methods; if not willing to pay for high-class man, don't answer. "Manager," care AMER. MACHINIST.

PENNSYLVANIA.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Superintendent, with executive ability and experienced in modern metal manufacture; toolmaker, with technical education; highest references from present employers. Box 724, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Young man as mechanical draftsman; must be capable and accurate; no other need apply; state experience, age, references and salary expected. Address Drawer 1343, Hartford, Conn.

We are constantly adding to our force, and invite applications from machinists, toolmakers, diesinkers, drop forgers, erectors and patternmakers, also lathe, screw machine and bench hands; in applying, please state age, experience and wages wanted. Locomotive Company of America, Bridgeport, Conn.

ILLINOIS.

A large structural steel manufacturing concern in Chicago invites applications from thoroughly competent men, for position of general foreman in their shop; applicants, to receive consideration, should state fully their experience, references and present place of employment; no applications are desired from men who do not consider themselves competent to secure the highest salaries paid for this class of service. Box 744, AM. MACH.

INDIANA.

Wanted—Experienced operator for universal milling machine, also a lathe hand for accurate tool work. Box 771, AMER. MACH.

IOWA.

Wanted—Machine shop foreman, experienced in agricultural implement work and capable of handling men and machinery by up-to-date methods and producing work at minimum cost; state age, experience, references, salary wanted. Address P. O. Box 5, Newton, Iowa.

Wanted—A first-class patternmaker for light high-grade work; must thoroughly understand fitting up patterns for molding machines; factory is situated in an up-to-date town of 20,000 population; married man preferred; kindly give references and salary expected; an excellent opportunity for the right man. Box 769, AMERICAN MACHINIST.

Wanted—Blacksmith shop foreman, for agricultural implement work, experienced in general blacksmithing, sheet metal work, punching, shearing and bulldozer work; capable of handling men and machinery by up-to-date methods and producing work at minimum cost; state age, experience, references, salary wanted. Address P. O. Box 5, Newton, Iowa.

MASSACHUSETTS.

Wanted—Experienced operators on Fellows gear shaper, Gleason planer, Jones & Lamson and turret screw machines. Boston Gear Works, Boston, Mass.

MICHIGAN.

Wanted—First-class man for milling machine; must be rapid and accurate; state age, experience, reference. Saranac Machine Co., St. Joseph, Mich.

Wanted—Electrician; experienced man, who can properly care for 25 dynamos and motors in a manufacturing plant, as well as take care of the light, power and telephone lines. Address Sheffield Car Co., Three Rivers, Mich.

Wanted—Man with technical training and shop and drafting-room experience, to teach shop drafting and machine tool design; do not apply unless familiar with modern shop methods; full particulars required; $1,200 annually for 9 months' work. Box 720, A. M.

NEW JERSEY.

Two first-class mechanical draftsmen wanted at once; state experience and salary expected. Box 762, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co, Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—A draftsman, experienced in small tool work, jigs and fixtures; one who has had experience in designing cams for Brown & Sharpe screw machine preferred; state age, experience and wages expected. Box 784, AMERICAN MACHINIST.

NEW YORK.

Wanted—A man with some experience in bending pipe. Address Box 788, AM. MACH.

Automatic screw machine operators; must be first class. Apply to The Western Electric Co., 748 Washington st., New York city.

Wanted—First-class, all-around machinists, machinery molders, also first-class machinery blacksmith. Box 785, AMER. MACH.

Milling-machine hands, with experience on tool work; must be first class. Apply to The Western Electric Co., 748 Washington st., New York city.

Purchasing agent, familiar with supplies for large structural plant and foundry. J. B. & J. M. Cornell Co., 26th st. and 11th ave., New York City.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7 ,Syracuse, N. Y.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 708, AMER. MACHINIST.

Wanted—Several competent outside erecting men on high-speed engine work. Reply, stating experience, previous employers and wages expected, Watertown Engine Company, Watertown, N. Y.

Foreman for shop manufacturing high-grade interchangeable specialty; desirable position for a thoroughly competent man; state age, experience and salary expected. Box 779, AMERICAN MACHINIST.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—At once, foreman patternmaker, experienced on medium and heavy pump and engine work; give details of past engagements and duration of same, wages received and expected; young man preferred. Address "State," care AMERICAN MACHINIST.

Shop Accountant and Cashier.—A manufacturing concern requires at once a thoroughly competent accountant, cashier and purchasing agent, familiar with these different lines of work, including general bookkeeping and modern cost systems. Address, with full particulars, stating salary expected, etc., Box 753, AMERICAN MACHINIST.

Speed boss or production engineer, as assistant to the superintendent of a company manufacturing steam and electric machinery; must be familiar with modern tools, speeds and methods of accurate and economical manufacture; salary $3,000 a year. Address, giving experience and qualifications, "A. B. C.," AMERICAN MACHINIST.

Wanted—Mechanical draftsman for leading position; one experienced on high-speed and Corliss engine work; one who can direct work and others, is familiar with and can carry out systematic methods; to receive consideration, give full details of past experience, salary received and expected. Address "Capital," care AMERICAN MACHINIST.

Wanted—Superintendent to take charge of an established and up-to-date plant manufacturing a line of A1 machine tools; must have push, energy and good executive ability, also be well up in modern machine shop practice; only men of ability need apply; state age, experience, salary expected, with references; all correspondence will be treated strictly confidential. Address Box 726, AM. MACH.

General Manager and Staff.—New company about to begin manufacture of an improved steam turbine, centrifugal pumps and turbine machinery on a large scale, desires to engage at once a general manager and necessary shop, office and sales assistants; applications are invited in confidence for different positions, stating fully the qualifications of the applicant for the position sought and salary expected. Permanent address should be given, as some positions may not be satisfactorily filled immediately. Address Box 748, AM. M.

OHIO.

Wanted—Mechanical designer and draftsman; must be experienced and practical; give full particulars. Address Box "P," Toledo, O.

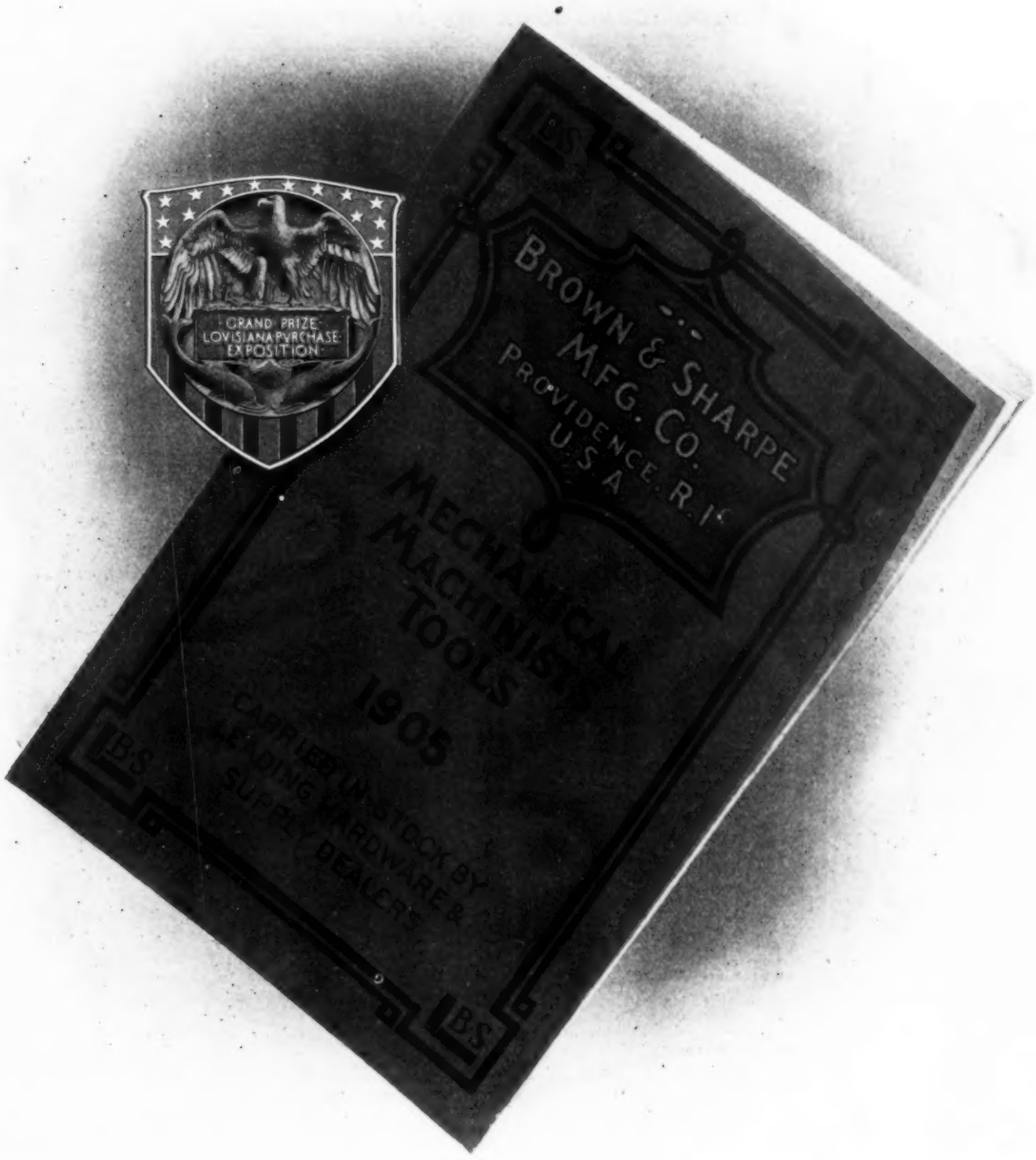
PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMER. MACHINIST.

Wanted—First-class toolmakers and draftsmen at once; first-class workmen on jig and fixture work for light, high-grade machinery. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

Wanted—Machinists and patternmakers. We are constantly adding to our force, and invite applications from machinists and patternmakers, preferably those accustomed to engine work. Shepherd Engineering Company, Franklin, Pa

Wanted, at Once—Designing draftsman; only those who have had actual experience in designing Corliss or similar engines considered; give previous engagements, duration, compensation received, how soon can come and



THE TOOL CATALOG No. 107

Free at Leading Hardware Dealers or Mailed to any Address

salary required. Shepherd Engineering Co., Franklin, Pa.

VERMONT.

Wanted—Young man, technical graduate, with machine shop experience, for assistant engineer. Vermont Marble Co., Proctor, Vt.

WEST OF MISSISSIPPI.

Wanted—General draftsman and designer, technical graduate, for growing concern in central California, manufacturing mining machinery especially; state age, experience, nationality and salary. Box 740, AMER MACH.

WISCONSIN.

Wanted—Energetic, hustling foreman for assembling floor; one experienced in gas and steam engines and heavy sawmill machinery; great latitude and spendid opening to right man; give age and full particulars. Box 777, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co.....140
Acme Machinery Co.....34
Adams Co. The.....110
Advance Mfg. Co.....189
Aibro-Clem Elevator Co.....178
Almond Mfg. Co., T. R.....152
Alteneder & Sons, Theo.....134
American Blower Co.....168
American Emery Wheel Wks.141
American Gas Furnace Co...145
American Pulley Co.....128
American School of Correspondence.....193
American Steam Gauge & Valve Mfg. Co.....137
American Tool Works Co.....8
American Tube & Stamping Co.198
Anderson & Sons Co.....139
Armstrong Bros. Tool Co.....103
Athol Machine Co.....138
Atlas Machine Co.....185
Auburn Ball Bearing Co.....191
Audel & Co., Theo.....198
Aurora Tool Works.....189
Automatic Machine Co.....101
Automatic Machine Co.....124

Backus Water Motor Co....136
Badger & Sons Co., E. B....195
Baird Machinery Co.....185
Baker Brothers....137 and 186
Baker Machine Co.....189
Baldwin Chain & Mfg. Co....166
Baldwin Steel Co.....132
Ball Bearing Co.....34
Barnes Co., B. F.....128
Barnes Co., W. F. & John....14
Barnett Co., G. & H...4th Cover
Bartlett, E. E.....172
Baush Mach. Tool Co.....108
Bay State Stamping Co.....176
Bay State Tap & Die Co.....184
Beaman & Smith Co., The...
15 and 150
Becker-Brainard Milling Machine Co.....23
Bemis & Call Hardware & Tool Co.....126
Bertram & Sons Co., Ltd., John.....87
Bertsch & Co.....160
Beskine Mfg. Co.....138
Besly & Co., Chas. H.....125
Bethlehem Fdry. & Mach. Co.121
Betts Machine Co.....6
Bickford Drill & Tool Co....10
Bignall & Keeler Mfg. Co....198
Bilgram, Hugo.....34
Billings & Spencer Co.....112
Binsse Machine Co....34 and 79
Birdsboro Steel Foundry & Machine Co.....109
Blaisdell Machinery Co.....162
Blanchard Mach Co.....34
Bliss Co., E. W.....25
Blount Co., J. G.....127
Boker & Co., Hermann.....83
Booth, Wm. M.....185
Boston Gear Works.....176
Bown Machine Co.....151
Boynton & Plummer.....120
Bradford Machine Tool Co....5
Bradley & Son, C. C.....187
Bridgeford Mach. Tool Wks..30
Bridgeport Safety Emery Wheel Co.....188
Bristol Co.....4th Cover
Brown-Cochran Co.....136
Brown Co., H. B.....189
Brown & Co., R .H.....150
Brown & Sharpe Mfg. Co....
73 and 4th Cover
Brown Hoisting Mach. Co....180
Buffalo Forge Co.....
98 and 4th Cover
Buffalo Steam Pump Co....
4th Cover
Builders Iron Foundry..3d Cover
Bullard Auto Wrench Co....202
Bullard Machine Tool Co....32
Burke Electric Co.....157
Burke Machinery Co.....144
Burr & Son, Jno. T.....180
Bury Compressor Co.....146
Butler, A. G.....180 and 195
Byram & Co., Inc.....134

Caldwell & Son Co., H. W....168
Carborundum Co., The.....30
Card Mfg. Co., S. W.....12
Carpenter Tap & Die Co., J. M.185
Carr Bros.....142
Case Mfg. Co.....166
C & C Electric Co.....163
Chadwick & Co., G. B.....195
Chambersburg Engr. Co.....
91 and 146

PAGE

Chandler Co., The.....160
Chandler & Farquhar.....185
Chattanooga Machinery Co....189
Chicago Flexibe Shaft Co....129
Chicago Rawhide Mfg. Co....174
Christensen, N. A.....146
Cincinnati Machine Tool Co..118
Cincinnati Milling Mach. Co.. 7
Cincinnati Planer Co.....22
Cincinnati Shaper Co.....206
Clark Cast Steel Cement Co..142
Clayton Air Compressor Wks.146
Cleveland Auto. Mach Co... 18
Cleveland Cap Screw Co.....119
Cleveland Crane & Car Co...166
Cleveland Pneumatic Tool Co.146
Cleveland Twist Drill Co., The.....171 and 4th Cover
Clough, R. M..123, 174 and 180
Coates Clipper Mfg. Co.....200
Cochrane-Bly Co.....203
Coes Wrench Co.....28 and 29
Colburn Machine Tool Co.... 22
Columbus Forge & Iron Co...133
Columbus Machine Co.....136
Cook Co., Asa S.....186
Cough, R. M..123, 174 and 180
Cornell, J. B. & J. M.....132
Crescent Forgings Co.....204
Cresson Co., Geo. V.....195
Crocker-Wheeler Co.....163
Crowe Name Plate & Engr. Co.....191
Cullman Wheel Co.....180
Cumberland Steel Co.....185
Curtis & Co. Mfg. Co.....146
Curtis & Curtis Co.....189
Cushman Chuck Co.....150
Cutler-Hammer Clutch Co....160

Dallett Co., Thomas H.....122
Davis Mach. Co., W. P.....100
Davis, Rodney.....174
Dayton Mach. & Tool Works..140
Dellinger, A. M.....191
Desmond-Stephan Mfg. Co....140
Detrick & Harvey Mach. Co..190
Detroit Screw Works.....196
Diamond Chain & Mfg. Co....141
Diamond Saw & Stamping Works.....123
Diamond Machine Co...3d Cover
Dickinson, Thos. L.....140
Dill Machine Co., T. C.....170
Dixon Crucible Co., Joseph...128
Dodge & Day.....190
Dreses Machine Tool Co.....116
Drucklieb, C.....146
Durant Co., W. N.....134
Durbrow & Hearne Mfg. Co..138
Dwight Slate Mach. Co.....181

Earle Gear & Mach. Co.....180
Eastern Machinery Co.....142
Eberhardt Bros. Machine Co.176
Eck Dynamo & Motor Wks...160
Electro-Dynamic Co.....164
Elmes Engr. Works, Chas. F.178
Emmert Mfg. Co.....138
Erie Forge Co.....170
Erie Stamping & Mfg. Co...142
Errington, F. A.....151
Evans Friction Cone Co.....167
Excelsior Needle Co.....104

Fairbanks Co.....97 and 184
Farrel Fdry. & Machine Co..131
Fawcus Machine Co.....179
Fellows Gear Shaper Co.....179
Felt & Tarrant Mfg. Co.....134
Felton, Sibley & Co.....138
Fenn-Sadler Machine Co....127
Ferracute Machine Co.....205
Field, Chas. H.....133
Firth-Stirling Steel Co.....130
Fitchburg Machine Works.... 89
Foos Gas Engine Co.....136
Foote Bros. Gear & Mach. Co.176
Foote, Burt & Co.....127
Fosdick Machine Tool Co.... 15
Frankin-Moore Co.....167
Franklin Mfg. Co.....105
Frasse Co., Peter A.....132
Frost, E. J.....191
Fuchs & Lang Mfg. Co.....132
Fulmer, Chas. F.....146

Ganschow, Wm.....178
Garvin Machine Co., The.....183
Geier Co., P. A.....151
Gem Mfg. Co.....177
General Electric Co.....156
General Mfg. Co.....145
General Pneumatic Tool Co..192
Geometric Tool Co.....23
Gilmore Electric Co.....162
Gisholt Machine Co.....91

PAGE

Gleason Works.....4th Cover
Globe Machine & Stamping Co.204
Goldschmidt Thermit Co.....132
Goodell Mfg. Co.....186
Goodell-Pratt Co.....147
Gorton Machine Co., Geo....195
Gould & Eberhardt.....77
Graham Mfg. Co.....138
Grant Gear Works.....174
Grant Mfg. & Mach. Co.....177
Grant-Nelson Tool Co.....190
Gray & Prior Mach. Co.....186
Gray Co., G. A.....34
Greaves, Klusman & Co.....195
Greenfield Machine Co.....106
Greenwald Co., I. & E.....176

Hammacher, Schlemmer & Co. 79
Hampden Corundum Wheel Co.140
Harrington, Son & Co., Inc., Edw.....169
Hardinge Bros.....125
Harrison Co., H. K.....151
Hart Mfg. Co.....134
Hartford Steam Boiler Insp. & Ins. Co.....136
Heald Machine Co., The.....147
Heller Bros. Co.....132
Hendey Machine Co.....81
Henley Publishing Co., Norman W.....97
Henry & Wright Mfg. Co.....165
Heppenstall Forge & Knife Co.195
Hess-Bright Mfg. Co.....135
Hill, Clarke & Co.....
131, 182 and 184
Hill-Standard Mfg. Co.....151
Hilles & Jones Co.....184
Hinckley, F. C.....190
Hisey-Wolf Machine Co.....85
Hoefer Mfg. Co.....135
Hoggson & Pettis Mfg. Co....185
Hoist, Mfg. & Construction Co.185
Hopkinson Machine Works...138
Horton & Son Co., E.....150
Hosburgh & Scott Co..4th Cover
Houghton & Richards Co.....132
Howard Iron Works.....189
Howson & Howson.....190
Huggins, Thos. J.....183
Hunt Co., C. W.....166
Hunt & Co., Robt. W.....146
Hurlbut-Rogers Mach. Co.....114
Hyatt Roller Bearing Co.....189

Ide & Sons, A. L.....182
Independent Pneu. Tool Co..197
Ingersoll Milling Mach. Co...140
Ingersoll-Rand Co.....20
International Corres. Schools.109
International Specialty Co....140
Iroquois Machine Co.....190

Jacobs Mfg. Co.....95 and 150
Jacobson Mach. Mfg. Co.....136
Jantz & Leist Electric Co.....160
Jeffrey Mfg. Co., The.....182
Jenkins Brothers.....142
Johnson Machine Co., Carlyle.113
Jones & Lamson Machine Co.
26, 27 and 34

Keep, W. J.....188
Kelly Co., R. A.....117
Kelsey, Duane J.....134
Kempsmith Mfg. Co.....24
Kent & Co., Edwin R.....130
Keuffel & Esser Co.....134
King Machine Tool Co.....197
Knecht Bros. Co.....188

Landis Machine Co.....197
Landis Tool Co.....75
Lang Co., G. R.....185
Lapointe Machine Tool Co...189
Le Blond Machine Tool Co., R. K....98, 173 and 4th Cover
Le Count, Wm. G.....150
Link-Belt Engineering Co....199
Lobben, Peter.....190
Lockwood, Arthur J.....133
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The...141
Lucas, J. L.....191
Lucas Machine Tool Co.....114
Lufkin Rule Co.....137
Lunkenheimer Co., The.....142
Lutter & Gles.....142
Lyon Metallic Mfg. Co.....133

McBarron Co.....189
McCabe, J. J.....129 and 182
McGeorge & Sons.....187
McGlehan & Co., C. H.....188
McInnes Steel Co.....191
Machinists' Supply Co.....204
Manhattan Automobile School.191
Marbach, F. C.....191
Maris Bros.....167

PAGE

Marshall & Huschart Mch. Co.183
Marston & Co., J. M.....151
Mass. Tool Co.....123
Massachusetts Saw Works....124
Massey Machine Co.....192
Mathews, Hugh.....142
Mechanical Accountant Co...184
Mechanics' Machine Co.....128
Merrell Mfg. Co.....151
Merrill Bros.....138
Merritt & Co.....185
Mersfelder Pattern Co.....189
Messmer Mfg. Co., Ferd.....176
Mietz Iron Fdry. & Mach. Works, August.....136
Millers Falls Co.....178
Miner & Peck Mfg. Co.....122
Mitts & Merrill.....195
Modern Tool Co.....150
Moline Tool Co.....146
Montgomery & Co.....102
Moore Co., Franklin.....167
Morse Chain Co.....194
Morse Twist Drill & Mach. Co. 33
Morse, Williams & Co.....176
Morton Mfg. Co.....146
Morton & Co., B. K.....133
Motch & Merryweather Mchry. Co.....183
Mueller Mach. Tool Co.....121
Mumford & Co., E. H.....180
Mutual Machine Co.....182

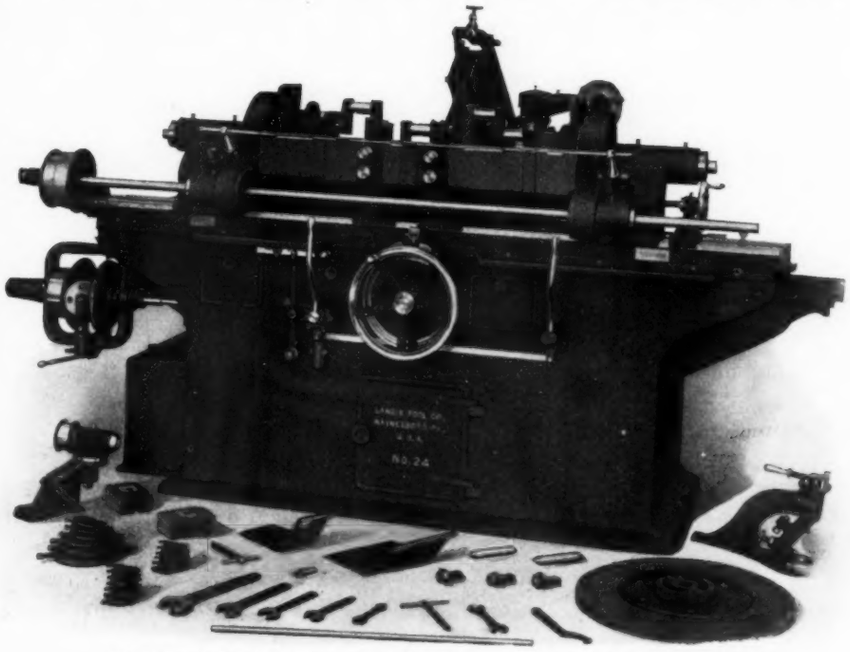
Narragansett Mach. Co.....195
National-Acme Mfg. Co.....206
National Corundum Wheel Co.140
National Machinery Co.....113
National Separator & Machine Co.....180
New Britain Machine Co.....126
New Era Gas Engine Co....136
New Era Mfg. Co.....133
New Haven Mfg. Co.....117
New Process Raw Hide Co...175
New Process Twist Drill Co..178
New York Telephone Co.....160
Newton Mach. Tool Wks., Inc. 11
Niagara Mach. & Tool Wks.120
Nicholson File Co.....16 and 17
Nicholson & Co., W. H.....165
Niles-Bement-Pond Co.....
182, 184, 207, 208, 209 and 210
Nolte Brass Co.....142
Northern Electrical Mfg. Co..164
Northern Engineering Works.
166 and 167
Norton Emery Wheel Co.....107
Norton Grinding Co.....99
Nuttall Co., R. D.....174
Nutter, Barnes & Co.....143

Obermayer Co., S.....178
Oil & Waste Saving Mach. Co.166
O K. Tool Holder Co.....190
Olds Gasoline Engine Works..136
Oneida National Chuck Co....185
Oneida Steel Pulley Co.....96
Orillia, Canada.....191
Owen Machine Tool Co.....116

Parker Co., Chas.....139
Patterson, Gottfried & Hunter, Ltd.....192
Pawling & Harnischfeger....166
Paxson Co., J. W.....132
Pelton, Wm.....96
Philadelphia Bourse.....123
Philadelphia Gear Works....174
Phillips & Sons Co., F. R.....144
Phoenix Mfg. Co.....178
Phosphor Bronze Smelting Co.133
Pilton, Wm.....96
Poole Co., J. Morton.....115
Potter & Johnston Mach. Co. 81
Pratt Chuck Co.....155
Pratt Institute.....191
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co...
149 and 182
Prentiss Vise Co.....138
Pressed Steel Mfg. Co.....151

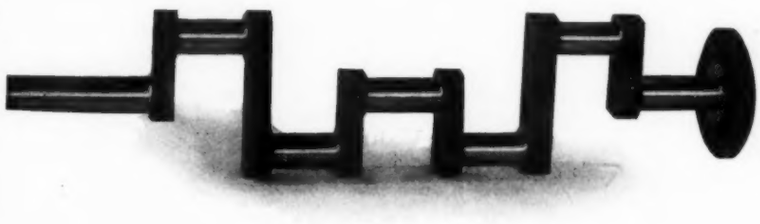
Ransom Mfg. Co.....119
Reece Co., E. F.....134
Reed Co., The H. E.....138
Reed Mfg. Co.....181
Reeves Pulley Co.....31
Reichheim & Co., E. P..4th Cover
Reisner Mfg. Co., W. H.....192
Reliance Machine & Tool Co..187
Rich, J. & G.....134
Richmond Elec. Co.....160
Ridgway Dynamo & Engine Co.....164
Risdon, S. A.....134
Rivett-Dock Co.....3d Cover
Rivett Lathe.....3d Cover
Robbins, L.....143

A Grinder for Automobile Builders



No. 24 Crank Grinding Machine—16 inch Swing; longest crank will drive 60 inches.

The Landis No. 24 Crank Grinding Machine meets the requirements of automobile work better than any tool yet designed. For grinding single and multiple crank shafts, for gas, petrol and small steam engines, such as are used in automobiles, launches, etc., it is positively unequalled. It handles multiple crank shafts with throws up to 6 inches, and single ones with throws up to 12 inches. Has all the Landis characteristics.

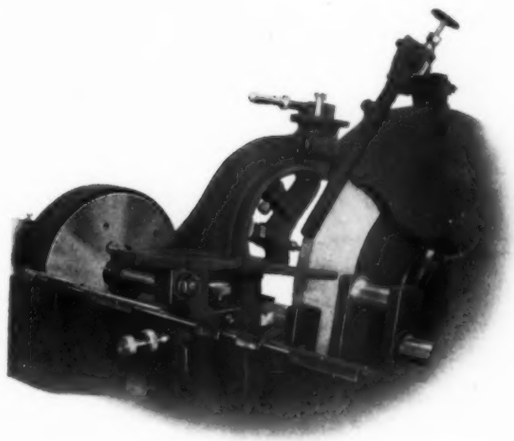


This Crank Shaft

is an example of Landis No. 24 Grinders's work. Parts ground, four wrists, 1½ inches diameter, 3" long; 3 journals 1¾" diameter; 3", 4", and 6" long, respectively. 1-32" removed; time 1¼ hours

Emery Wheel Truing Device

for truing face of wheel, also for truing the corners to an exact radius for grinding fillets. As regularly provided, it is for giving wheels correct shape for grinding fillets with radius up to one-half inch. A shown in illustration, it is clamped to top of stationary rest. Work need not be removed in order to true the wheel.



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PAGE

Robertson Mfg. Co..... 93
Rogers, Boat, Gage & Drill Works, John M.....145
Rogers & Hubbard Co.....128
Roth Bros .& Co.....162
Rowbottom Machine Co.....150
Royal Metal Steel Co.....132
Royersford Fdry. & Mch. Wks.140
Safety Emery Wheel Co.....124
Saunders' Sons, D.....178
Sawyer Gear Works.....174
Schacht Mfg. Co.....191
Schellenbach & Radcliffe.....126
Schieren & Co., Chas A.....148
Schumacher & Boye..... 9
Schwerdtle Stamp Co.....191
Scranton & Co.....204
Sebastian Lathe Co.....120
Sellers & Co., Inc., William.. 34
Seneca Falls Mfg. Co.....108
Severance, W. E.....134
Shaw & Co.....178
Shepard Lathe Co.....191
Shepherd & Parker.....190
Shultz Belting Co..... ...139
Sibley Machine Tool Co.....134
Simonds Mfg. Co.....174
Simplex Mfg. Co.....191
Simplex Time Recorder Co...112
Skinner Chuck Co.....150
Slocomb Co., J. T.....154
Smith, Ernst G.....134
Smith Fdry. Supply Co., J. D.133
Smith & Mills.....185
Spaulding Print Paper Co....195

PAGE

Speed Changing Pulley Co...139
Spicer Universal Joint Mfg. Co.....176
Sprague Electric Co.....159
Springfield Machine Tool Co..125
Stafford, H. S.....184
Standard Connecting Rod Co.136
Standard Engineering Works.188
Standard Gauge Steel Co.....196
Standard Roller Bearing Co..190
Standard Tool Co.....155
Standard Welding Co.....111
Stanley G. I. Elec. Mfg. Co..158
Star Corundum Wheel Co....204
Stark Tool Co.....180
Starrett Co., L. S.....154
Steel Set Diamond Co.....140
Steffey Mfg. Co.....136
Steptoe Shaper Co., John....191
Stevens, F. B.....133
Stoever Fdry. & Mfg. Co....204
Stow Mfg. Co.....162
Straley & Hasbrouck.....190
Struthers-Wells Co.....136
Sturtevant Co., B. F.....13
Superior Corundum Wheel Co.197
Swaine Co., Fred J.....170
Switchboard Equipment Co...161
Syracuse Raw Hide Co.....174
Syracuse Twist Drill Co.....134

Tabor Mfg. Co.....121
Taylor-Wilson Mfg. Co.....177
Thompson, Hugh L.....195
Three Rivers Tool Co.....191

PAGE

Tighlman Brooksbank Sand Blast Co..... 188
Tindel-Morris Co.....137
Toomey, Frank..... 184
Triumph Electric Co.....194
Trump Brothers Machine Co.186
Tulley & Co., Henry C.....186
Tuohy Bros..... 185
Turley, H. G.....176

Underwood & Co., H. B..... 93 and 122
Union Twist Drill Co..... 85
Universal Drafting Mach. Co.135
U. S. Foundry & Sales Co....132
U. S. Indestructible Gasket Co..... 133

Vanderbeek Tool Works.....189
Vandyck Churchill Co..... 19
Veeder Mfg. Co..... 188
Vickers, Sons & Maxim.....133
Vitrified Wheel Co.....188
Von Wyck Machine Tool Co.127

Walker & Co., O. S.....151
Wallace Supply Co.....185
Waltham Watch Tool Co....197
Ward & Sons, Edgar T.....132
Warner Instrument Co.....144
Warner & Swasey Co..... 83
Waterbury Farrel Foundry & Mach. Co..... 141
Watson-Stillman Co.... 110
Webster & Perks Tool Co....118

PAGE

Wells Bros. Co..... 31
West Haven Mfg. Co..... 166 and 4th Cover
Westcott Chuck Co.....150
Western Tool & Mfg. Co.....122
Westinghouse Elec. & Mfg. Co.157
Westmacott Co., J. M.....197
Whatley, A. H.....178
Whitcomb-Blaisdell Machine Tool Co.....21 and 87
Whitman & Barnes Mfg. Co..201
Whitney Mfg. Co..... 71
Whiton Mach. Co., D. E.....153
Wiley & Russell Mfg. Co..... 97
Wiley & Sons, John.... 34
Williams & Co., J. H.....164
Williams Tool Co.....186
Williams, White & Co.....143
Williamson Mfg. Co.....138
Wilmarth & Morman Co....186
Windsor Machine Co.....115
Winkley Co..... 195
Wood's Sons, T. B.....126
Woodward & Powell Planer Co..... 111
Worcester Mach. Screw Co...188
Worcester Pressel Steel Co..160
Wormer Machinery Co., C. C.183
Wright, Harold A..... 167
Wyke & Co., J.....183
Wyman & Gordon.....4th Cover

Yale & Towne Mfg. Co.....168

Zeh & Hahnemann.....178

Classified Index of Articles Advertised.

Abrasive Materials
Abrasive Material Co., Phila., Pa.
American Emery Wheel Works, Providence, R. I.
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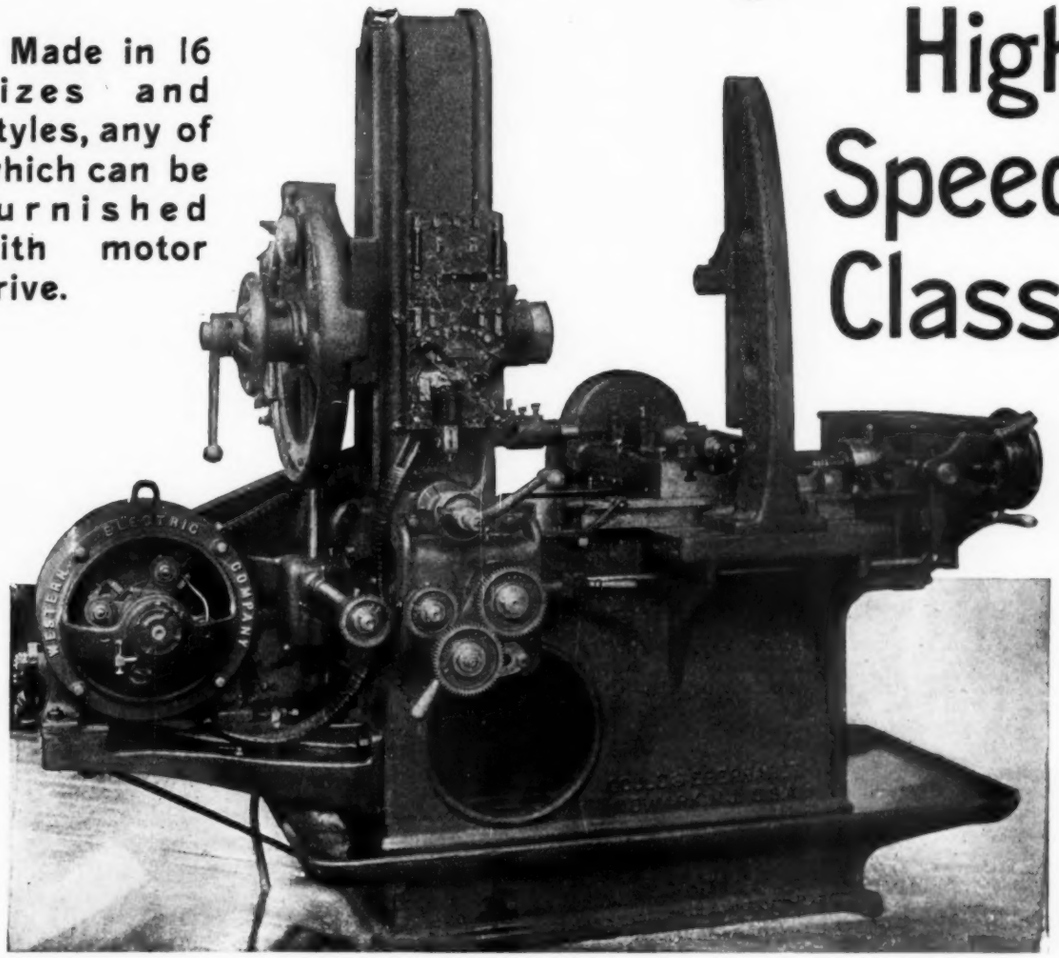

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Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Montgomery & Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels

Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons, T. B., Chambersburg, Pa.

Cranes

Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Hoist, Mfg. & Const. Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
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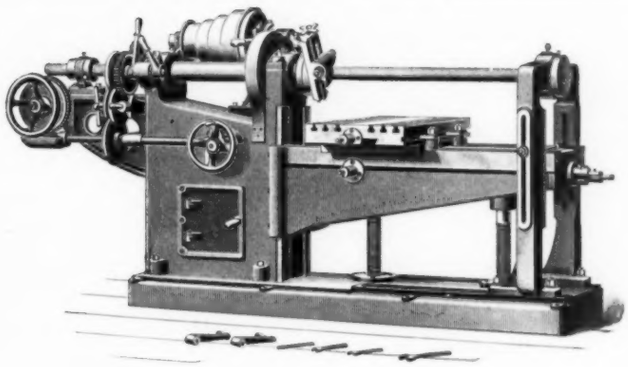

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Warner Instrument Co., Beloit, Wis.

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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Montgomery & Co., New York.
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Pratt & Whitney Co., Hartford, Conn.
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Union Twist Drill Co., Athol, Mass.
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Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
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Vandyck Churchill Co., New York.

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Billings & Spencer Co., Hartford, Conn.
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Goodell Mfg. Co., Greenfield, Mass.
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O. K. Tool Holder Co., Shelton, Conn.
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Dickinson, Thos. L., New York.
Montgomery & Co., New York.
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Lucas, J. L., Bridgeport, Conn.
Lutter & Gies, Milwaukee, Wis.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Swaine Co., Fred J., St. Louis,
Zeh & Hahnemann, Newark, N. J.

Dies, Sub-Press
Risdon, S. A., Waterbury, Conn.

Dies, Threading, Opening
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Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
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Dwight Slate Mach. Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
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Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.

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Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Dwight Slate Mach. Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.

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Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

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Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.

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American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
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Barnes Co., W. F. & John, Rockford, Ill.
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Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
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Davis Mach. Co., W. P., Rochester, N. Y.
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Fenn-Sadler Mach. Co., Hartford, Conn.
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Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

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Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
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Niles-Bement-Pond Co., New York.
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Curtis & Curtis Co., Bridgeport, Conn.
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Parker Co., Chas., Meriden, Conn.
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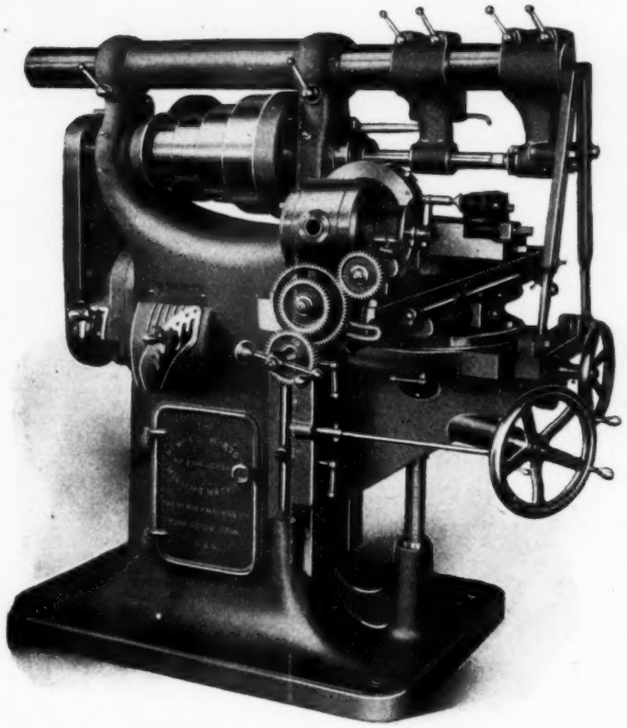

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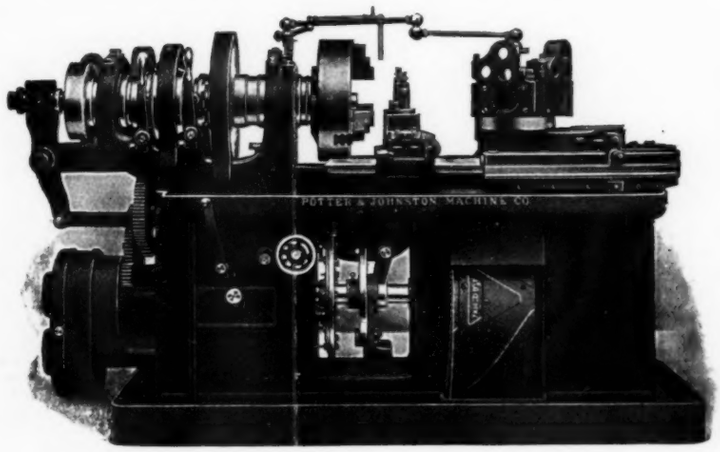

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Mietz, August, New York.
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Sturtevant Co., B. F., Hyde Park, Mass.

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Billings & Spencer Co., Hartford, Conn.
Columbus Forge & Iron Co., Columbus, O.
Crescent Forgings Co., Oakmont, Pa.
Montgomery & Co., New York.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Anderson & Sons Co., Detroit, Mich.
Baldwin Steel Co., New York.
Columbus Forge & Iron Co., Columbus, O.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
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Bristol Co., Waterbury, Conn.

Gauges, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Marbach, F. G., Medina, O.
Mass. Tool Co., Greenfield, Mass.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam

American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Davis Mach. Co., W. P., Rochester, N. Y.
Lunkenheimer Co., Cincinnati, O.
Montgomery & Co., New York.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.

Gear Cutting Machinery *Continued*

Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Turley, Harvey G., St. Louis, Mo.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co. New Bedford, Mass.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Montgomery & Co., New York.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Turley, Harvey G., St. Louis, Mo.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide

Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse ,Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Some Observations on Oil Burners.

BY JOHN J. SMITH.

The very interesting editorial correspondence at pages 377 and 426, on the subject of burning fuel oil, and the burners used for that purpose, in southern California, brings to my mind some experiences along parallel lines which may merit a sort of reflected interest.

The particular point which caught my attention was Mr. Halsey's accurate allusion to the "drumming" of these burners as "a series of incipient explosions." Something less than a year ago I acquired a little experience, under high pressure, with oil burners, which has been mentioned in an article on "An Improved Air Compressor," at page 233, and it is the experience then acquired which it is now intended to briefly describe.

The oil burners in question, shown in Fig. 1, were made in great haste and in almost total ignorance of the details of their construction, as far as experience was concerned. A piece of ¼-inch pipe was welded shut on one end and a 1-16-inch hole drilled through this end. On the other end of this pipe a long thread was cut, which was screwed into a bushing, filling the rear end of a ¾-inch T. At the side of the ¾-inch T the air entered through a nipple and hose. The ¾-inch pipe in the front end of the T in the first burner made was about the same length of the ¼-inch pipe inside (about four feet long), and on its end was screwed a reducer, into the end of which a ½-inch nipple, about 4 inches long, was screwed.

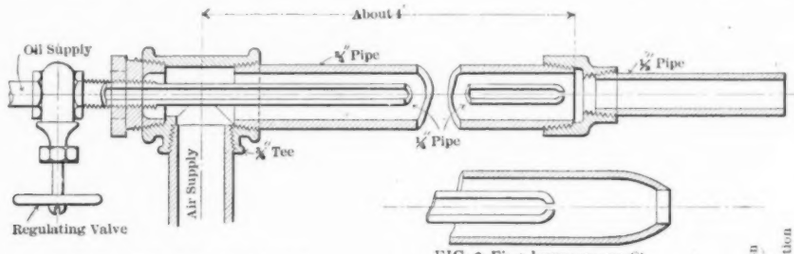

FIG. 1 First and Correct Construction of Burner

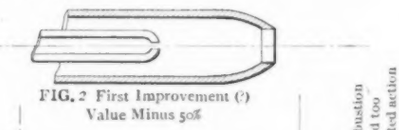

FIG. 2 First Improvement (?) Value Minus 50%

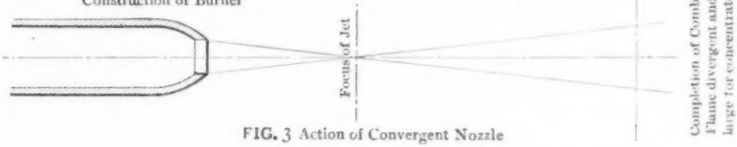

FIG. 3 Action of Convergent Nozzle

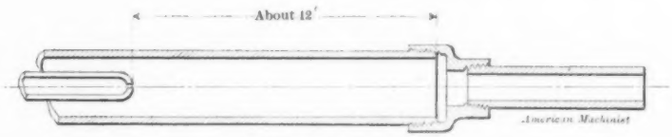

FIG. 4 Second Improvement (?) Value Minus 100%

EXPERIMENTS WITH OIL BURNERS.

This burner was very successful, though used under lighter air pressures than those we subsequently obtained, but having been the first one made, it was perhaps natural to think that subsequent ones should be better; so desiring another, the ¾-inch pipe was drawn down by a smith to a conical end or jet, much better looking than the reducer and ½-inch nipple, as shown in Fig. 2. But after full and fair trial, it was found impossible to get the concentration of heat in one place with this that was obtained with the other, for the reason that under the heavy pressure of air the velocity of efflux was so great that combustion was not complete until a point was reached something like 1½ feet beyond the end of the burner. With the conical nozzle the jet action had ceased, and the lines of flow of the flame had ceased to be convergent and had become divergent within less than a foot; consequently, the flame was without any accurate center, and was quite rapidly divergent at the point where combustion was complete, and where the greatest heat should have been if it had been properly concentrated, all as shown in Fig. 3. The ½-inch nozzle, by permitting the flow to be approximately parallel, enabled the combustion to be complete within a small area at whatever distance from the burner might be necessary within reasonable limits, and therefore focussed the activity of the flame much better than the convergent nozzle. This at least seemed to be the theory, and these certainly were the facts, as was clearly proven by cutting off the convergent nozzle and substituting for it the reducer and ½-inch nipple.

Another improvement, shown in Fig. 4, was attempted, with the object of heating oil further by the action of the ¾-inch pipe upon it before it reached the point of discharge. It should have been stated above that the oil was delivered by pipe and hose connection to a barrel placed at the top of the furnace, some seventy feet above, so that there was a very good head to drive it through the 1-16-inch hole, and a sufficient quantity emerged to make a very large flame. The quantity was regulated by a ¼-inch globe valve on the projecting end of the ¼-inch pipe, at whose other end was the 1-16-inch orifice. The operator regulated the action of the blowpipe by opening or closing this valve minute amounts to suit conditions, and also fed the nozzle or drew it back so as to keep the hottest part of the flame on the point where the melting was desired to take place. The improvement which was attempted consisted in cutting off the ¼-inch pipe which carried the oil about one foot, so that the oil had to traverse about a foot of space through the ¾-inch pipe in the form of jet sprayer, or along the bottom of the ¾-inch pipe before reaching the ½-inch nozzle, the idea being that it would in this way be preheated more than by simply passing through the ¼-inch pipe for the same distance.

The attempt to operate this burner was most exasperating and unsatisfactory. If the valve were regulated to bring the flame to the right condition, it would sustain itself for a brief instant, go out, and be followed by a surplus of oil which re-ignited against the hot surface and made a detonating mixture with the air with which it had become mixed during the instant of extinction, so that virtually the action of the burner was no more than a series of sharp explosions at intervals of about a second, with of course no useful heating effect. No regulating of the valve sufficed to cure this most objectionable condition, but finally close observation showed that coincidently with the flashes of re-ignition there came a few drops of oil in liquid form, *not* spray, from the end of the ½-inch nipple. It was these which supplied the excess of combustible and made the smoky flame accompanying the explosions (which of course were perfectly harmless in their nature). When this was seen the secret was out. The oil was not driven with sufficient force to throw it entirely into spray at the base of the ½-inch nozzle, but some of it ran down and along the bottom of the ¾-inch pipe, whence it was picked up and carried in waves by the action so familiar to all in such cases, with the result that there was first an excess and then a deficiency of fuel for the air, the supply of which was constant. A longer ¼-inch oil pipe was at once procured which delivered the oil just at the base of the ½-inch nozzle, where the high velocity of the air consequent on the reduction of area caught it and threw it into a perfect spray, so that the action was complete and continuous. This perhaps may be a useful experience for those who have to do with oil burners as a regular occupation, and may supply a clue by which the drumming, of which Mr. Halsey speaks, may in time be com-

pletely obviated. In the case I have just described, the explosions were separated, as already stated, by an interval of a second or perhaps more, but they were regular and continuous, and it requires no stretch of imagination to make one realize that under slightly different conditions they might be sufficiently close together to give the effect of drumming. Just what the conditions are which produced this action in the burners described by Mr. Halsey it is of course impossible for me to say, but that they are due to a rythmical action not unlike that which I have described, I have very little doubt.

Another point of much interest in connection with these oil burners came to light during the brief experience of which mention has been made. This was that the burner did better as the hole in which it was working was deeper. The reason was not very far to seek. When the hole was quite deep, say 2 feet, and of comparatively small diameter, the flame which, had it been unobstructed, would have gone perhaps seven or eight feet beyond the end of the burner, was compelled, by striking the object of its attack, to return on its course and come back over the burner itself. The result would have been that the burner would have been heated to a white heat in a very few minutes had it been a piece of "dead" pipe of the same size in the same flame, but as a matter of fact the burners never showed the least inclination to get even red-hot, being cooled by the rapid current of air through them. The other phase of this fact is that the air must have been heated before leaving the burner to a very considerable degree. One could even imagine that it may have been five or six hundred degrees Fahr., though naturally no effort was made to determine the amount at that time.

Just what the flame temperature in such a case is, I do not know. Theoretically, it would probably be 3,500 degrees, or perhaps more, but actually would not likely be above 3,000 degrees. If, now, the fusion point of the substance to be melted were 2,500 degrees, then an increase of 500 degrees in the temperature of the air, giving an increased flame temperature of perhaps 400 degrees, would make the latter 3,400 degrees instead of 3,000 degrees; and while this is not a very great difference absolutely or relatively, based on the *total* temperature, when compared with the fusion temperatrure (assumed to be 2,500 degrees), it is seen to be almost twice as great a difference, implying twice as much heat available for melting operations, as well as nearly twice the "thermal head" for causing the heat to flow from the flame to the object being melted. Moreover, it is almost certain that the oil inside of the ¼-inch pipe was somewhat preheated also, and therefore its vaporization at its exit from this pipe was much quicker and more complete. Those who have seen Lucigen and Wells lights, for outdoor operations where electric light is not available, may have noticed that the flame starts from the bottom of an open coil of pipe and passes out through this coil, the oil coming to the jet through the pipe which forms the coil. In this way the oil becomes highly heated and passes at once into vapor, which burns with a clear smokeless flame at its exit. That the preheating is a necessity of the operation is shown by the fact that these lamps can only be started by burning some oil or greasy waste in a tray beneath the coil and heating it up to such a point that this vaporization can take place. Without this action the jet simply throws a solid stream of oil, which may burn precisely as oil running down a wire might do, but will not give the clear, long flame of a fluid emerging under pressure, as these lights do when once in complete operation. The plumber's lamp, or blow-torch, is a precisely similar illustration of the same thing on a smaller scale, though they use gasolene, which is much more volatile and therefore requires much less preheating than is required for kerosene. In general it may be said that the subject of preheating the materials of combustion, both fuel and air, is a subject the importance of which is quite generally under-rated; that it does not merely lead to an improvement in fuel economy, but that it makes possible things which would be quite impossible without it. The most notable illustration of this latter fact is the open hearth steel melting furnace, which year by year is producing an increasing percentage of our total output of steel.

This effect was secured in starting holes with the oil burner by the simple expedient of putting against the surface to be attacked, a piece of 5- or 6-inch pipe about 2 feet long, luting up the crack between them with clay and starting the burner inside this pipe; this compelled the flame to return over the burner and secured the advantage of the deep hole from the start.

It happened in one of those manufacturing plants, too small to give a machinist steady employment and too mean to send the work out to the local machinist. The "hobo" machinist was haggling with the proprietor over the pay he was to receive for three hours work lining up the engine.

"I've been three hours on the job, at 30 cents an hour. That makes 90 cents."

"Three hours? Thirty cents an hour? Here's 50 cents and even that's 25 cents too much. You don't think I've been employing machinists off and on for the last twenty years for nothing do you?"

"Well, if you haven't," replied the machinist gathering up the quarter, two dimes and one nickel, "I'll bet it wasn't your fault."

Kremnite, made in the neighborhood of St. Petersburg, is a new building material composed of clay, sand and fluorine, subjected to a high temperature and molded into any form required, while it can be colored to imitate the most precious marbles.

Molding Machine Equipment.

BY T. E. VANDERSLICE.

In my travels among the foundries of an Eastern city a few months ago, I chanced to observe a molding machine equipped with a special device for drawing a certain section from the sand; this section was set at an angle of about 55 degrees, and one side of it formed a big back draft which could not be molded very nicely unless this special device was used. The particular job to which my attention was attracted can be seen in Figs. 2 and 3, and I also show in Figs. 6 and 7 another method of mounting the same job, as was suggested by one of the workmen; while it would work all right, yet I agree that the way it is shown in Figs. 2 and 3 is the most practical way, and it is giving good results in the foundry.

The parting line for the first method can be traced as follows in Fig. 1: starting at the end of the pattern designated by *C*, on the inside of the wide forks along the bottom of outline of the pattern to the point *E*1, and then up the dotted line to point *E*2, then along the top face of the pattern to the point where *L*1 and *L*2 meet. For the outside of the pattern, starting at point *C* it runs along the dotted line *L*1 to the top of the pattern, then along line *L*2, then on till it reaches the center of the hub *A* and across the center of this hub on line *L*3 to the opposite side, and from there down line *L*4 to the bottom edge of the pattern. On the sides of the pattern where *B* is formed the parting follows around the outer edge of *B* on line *L*5, then up line *L*6 to the top edge of the pattern, where the narrow forks *D* branch out from the pattern, and along line *L*7 on the outside of the forks to the center of the rounding on their ends, and from there down the building-up block *L* of Fig. 2 to the stripping plate *E*. The parting line on the inside of the fork *D* runs from the center of the round on its end down line *L*8 to point *L*9, then up dotted line to point *L*12 at the top face of the pattern. There might be a slight change in the parting line near lug *B*, so as to overcome making a special device for getting *B* out of the sand. This change in the parting is shown in dotted lines *V* of Fig. 3 and *V*1 of Fig. 2, the principal drawback to the change being that it forms a sharp pocket *V*3 in which the sand would stick unless nails were set in it to offset it; as nails should be avoided when possible, the special device, as shown in Fig. 3, is resorted to.

It will be seen by the above description of the parting line that it is very crooked, and to get two plates to conform to this parting line and yet fit perfectly with each other is quite a trick, which will be dealt with further on. For a few words of explanation of the various designating marks, I will say that *K*3 represents a portion of the cope pattern from line *O*

up to the center of the hub and along line *N* to lug *B*; it is on this section that the sprue is placed directly above hub *A*1. *K*4 is the remainder of the cope pattern and takes in all from lines *P* and *M* up to the patterns. *K*5 is a slight portion of the face of the pattern on the inside of the narrow fork *D*, Fig. 1; this runs down to *L*8 (see Fig. 3). *B* is a special device which is bolted to the under side of the building-up block.

SPECIAL SCREW DEVICE ON COPE PATTERN.

As the portion *B* is placed in a slanting position on the side of the pattern, it is, when the pattern is mounted as shown, necessary to draw it out of the sand in a slanting position; if mounted differently, with the end of the pattern cocked up so as to bring the sides of the lug *B* in a vertical position, so that it would easily draw down through the stripping plate by the straight vertical motion of the molding machine, then the remainder of the pattern would be in such a position as to re-

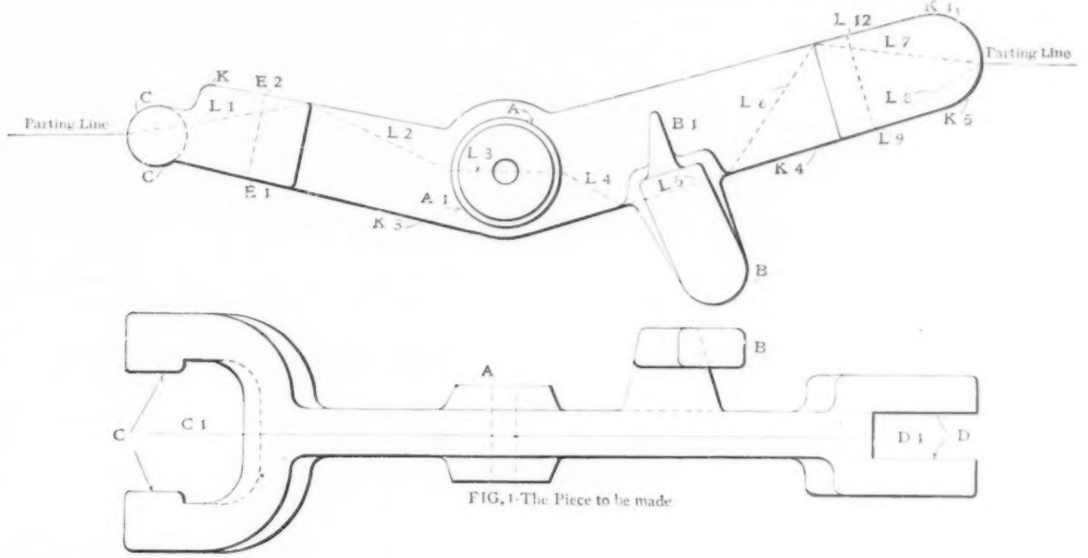

FIG. 1-The Piece to be made

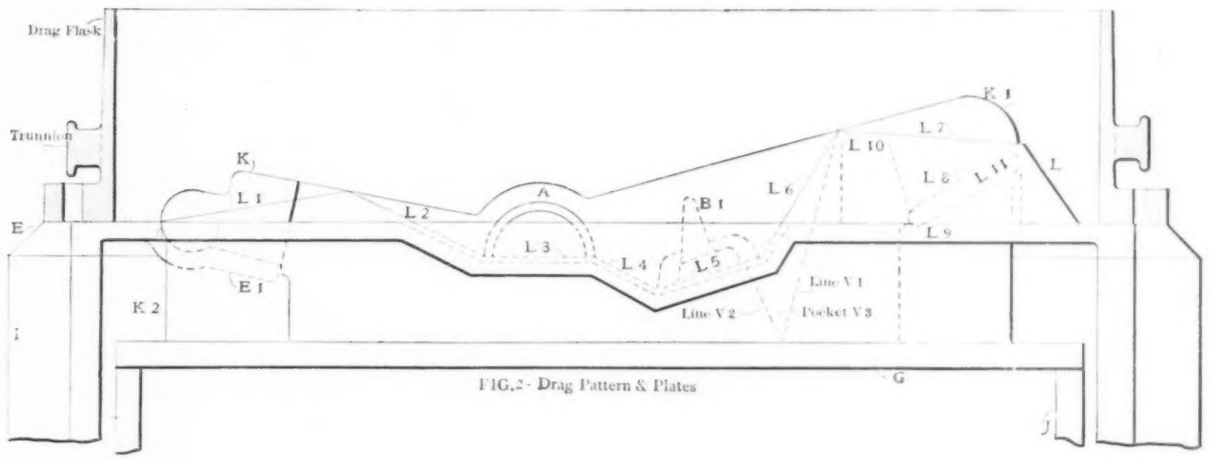

FIG. 2 - Drag Pattern & Plates

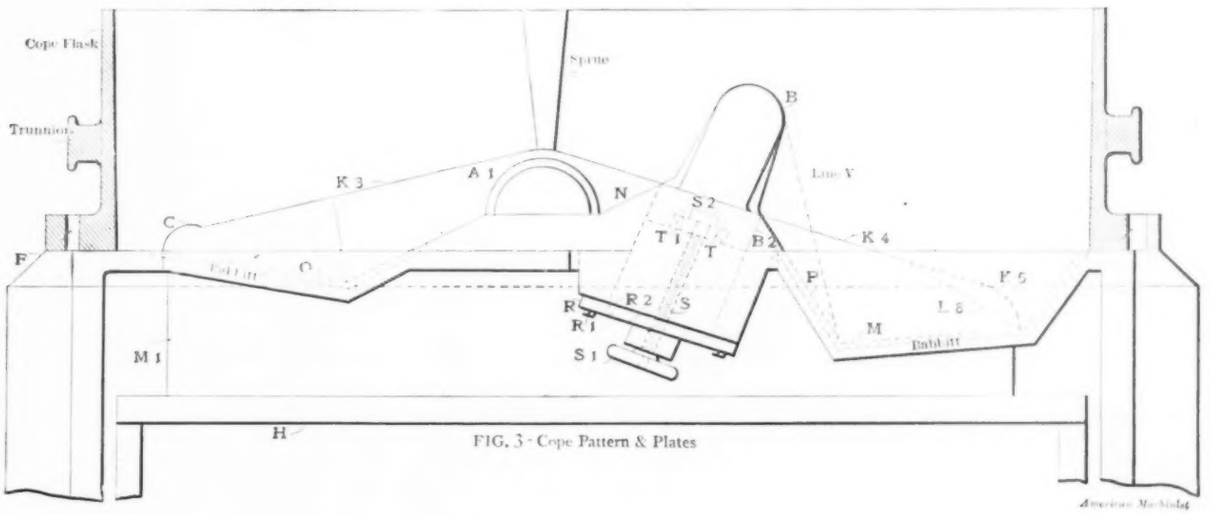

FIG. 3 - Cope Pattern & Plates

American Machinist

quire a special stripping plate cocked away up on one end and making a slant of about 30 degrees with the face of the stripping plate in order to save sand, and when the sand was shoveled into the flask it would slide down the incline on to plate and really pack harder at the lower end if great care were not taken to offset it. I mention these points, as they were some of the points brought up in discussing the mounting of the pattern and the construction and location of this special screw device. It is all done in the cope building-up block that fits around the pattern where the part *B* comes; an opening is made in the face of the building-up block to the size and shape of portion *B* at its base or at the point on line *L*5; the walls of this pocket act as a guide to the section *B* when drawing it out of the sand. On the under side of the building-up block running from line *L*5 is placed an additional piece about 1½ inches deep.

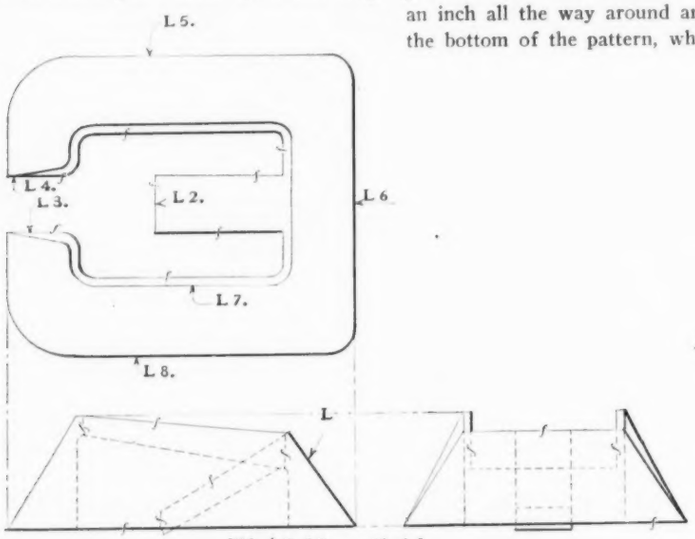

FIG. 4-Building up Block L

and with a hole in it to the same size as *B* at its base. This extra section is cast on the under side of the building-up block. Section *B* is filed to fit the hole in building-up block, so that there is no side motion within it as it works through the building-up block (see Fig. 10). This projection on the bottom of the building-up block makes it necessary to cut out the stripping plate to allow it to pass through. In the bottom face of section *B* is cut a two-step recess, see Fig. 3, and in the largest recess is fastened a plate *T* by means of screws *T*1. Through the center of plate *T* is drilled a hole slightly larger than the outside diameter of the screw *S*; this screw is made with a cap on it, which is designated by *S*2. On the other end of the screw is a hand-wheel, *S*1. The size and shape of the cap on the end of the screw is the same as that of the small recess in the face of *B*. A nut casting *R* is made, and drilled and tapped to fit the screw *S*. The nut *R* is then fastened to the under side of the building-up block by means of screws *R*1 (see Fig. 3). Around the sides of the nut casting are made the four openings to allow any sand that may get in there to fall out; these openings are designated by *R*2. By noticing the cut of this device it will be seen that the end cap on screw *S* is placed in the small recess in under face of *B*, the plate *T* is then fastened in place and the nut casting is then screwed on to the end of screw *S* and is then made fast to the under side of *B*, the hand-wheel then being slipped on the square formed on the end of screw, thus completing the special screw device.

SPECIAL POINT OF THE MASTER PATTERNS.

In the construction of the master patterns, the outline of the parting line is laid off on the side of the pattern, and about half an inch below this line another line is made; and from this last line the pattern is cut under about a quarter of an inch all the way around and down to the bottom of the pattern, where it rests on the pattern plate. This cut-under surface is designated by *M*1. The only part of the cope pattern that will be finished in the machines will be the under surface of the section *M*1, so on all other parts a file finish should be allowed. As the fork *C* is made all in the drag, the cope representative of that portion will merely be a flat surface to the outline of the pattern at that point, and to the width of the pattern from one outer side of the fork to the other outer side. The fork *D* is represented in the cope by the portion *K*5, which takes in all above line *L*8. In the construction of the drag section of the pattern, the forks are left open clear through to the bottom of the pattern, and the parting line is laid off as it was with the cope and is also cut under in the same way. In making the (master) pattern for the drag and cope stripping plates *E* and *F*, it is made to fit the machine and the flask to be used; then on both ends, where the flask pins will come, is an ear fastened to the stripping plate. These ears should come directly in the center of the ends of the plate, so through the centers of the ears is scribed a line clear across the plate, and from this line the pattern is located, with all its building-up blocks, by scribing their outline on its face; and all within this scribed outline of the pattern is cut out clear through the plate and a trifle smaller than the size of the pattern. At the points where the building-up blocks come, the plate is cut out a little larger than the pattern, because this section of the plate will not be fitted to the pattern as the building-up blocks will be. The plate must be cut out so as to let the projection on under side of building-up block go through without further fitting. The thickness of the plate where stock is cut out is about ½ inch and as it would be too much work to file so much surface to fit the pattern the plate is cut away, leaving about half of it to file, and in cutting it away it should be cut under about ¼ inch from the full size of the pattern. These two stripping plates are to be finished on top and bottom. In making the pattern plates, the cope plate has an opening cut in it to the size of the projection on the building-up block, and at the same location. The drag plate needs a plain flat plate, but an opening in it will do no harm, so the same pattern is used for both machines. A number of finishing pads should be placed over the top face of the plate to support the pattern; these pads will save a lot of planing. As there are no stools to this job, no stool-plate is mentioned.

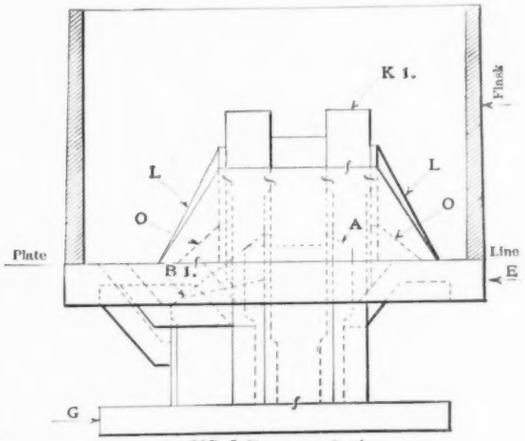

FIG. 5-Transverse Section

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In sending the master patterns to the foundry for castings desired, the foreman should be informed as to the particular portion of them which is to be planed and filed. The part that forms the pattern proper should be made in the drag, so that a plain file finish can be had without showing a lot of sand-holes. These castings, when they come out of the sand, should be pickled and sent to the machine shop.

MACHINING AND FITTING TO MOLDING MACHINE.

All plates should be planed to size and drilled to fit the molding machine, and the pattern proper should also be planed on bottom surface; then the fitting commences by filing the cope or drag section of the pattern to its correct size and shape; when the one side is finished, the two are placed together and the remaining half dressed to fit the shape of the first section, and when completed they should be laid carefully on the flat finished surface of the stripping plate, true with a scribed line made across the top of the plate through the flask-pin ears, and from this line locate the pattern. A little shifting of the pattern to fit the opening in the plate may be necessary, as the molders sometimes get the openings shifted in the plate, but a slight shifting of the pattern will do no harm. When the cope pattern is located on the cope plate, it should have its cut-back section *M*1 fitting in the opening of the plate while the full outline of the pattern is resting on the upper surface of the plate, as the pattern is prevented from going through the plate by the ledge on its under side. Before the pattern is set in the plates for marking its outline, the plate should be colored with a solution of blue-stone or copperas, as this will show up the outline scribed on the face of the stripping plate. When the pattern is set on the plate, take a scriber and scratch the outline of the pattern on the plate; then remove the pattern and dress out the hole in the plate till close up to this scribed outline; then red-lead the sides of the pattern and slip it up from the under side. If a slight draft was on the sides of the pattern from the parting line up and the filer filed the hole in the plate with a draft toward the under side of the plate, then this pattern will slip in easily, and if it binds at all it will be close up to the top face of the plate on the sides of the opening. With a file these binding spots can be filed down till the pattern will work up and down freely within the opening in the plate. The flask-pin holes are now put in the ears on end of plate directly on the scribed line, then the drag stripping plate is set on the top of the cope stripping plate, and if, when the two plates are resting with the two center scribed lines matching with each other, the opening in the drag plate shows it will finish up with the outline in the cope plate, then proceed to drill the flask-pin holes in the drag plate directly on the center line. Then put the two plates together again, the face of the drag plate being covered with bluestone near the edge of the opening; take a scriber and scratch the outline of the opening in the cope plate on the face of the drag plate. The two plates are then removed and the drag plate is filed out to the scribed outline, as was done with the cope plate, the drag pattern being fitted in as was the cope. The pattern plates are then placed on the top of the traveling carriage of the molding machine, while the stripping plates are placed on the top of the machine, both plates being located by dowel pins and held fast by screws. The traveling carriage is then let away down, and the cope and drag patterns are slipped in on the pattern plate directly under the opening in the stripping plates; then the carriage of the molding machine is elevated to the uppermost position, the pattern entering the plates and the section that represents the pattern proper will be protruding above the top face of the stripping plate; then the outline of the pattern at its base can be scribed on the top face of the pattern plates. The building-up blocks are then dressed to size and shape and fitted to the sides of the pattern where needed for parting; these building-up blocks are then fastened to the top face of the stripping plates by screws from underneath, the pattern and plate being removed from the machine and the pattern made fast to the plate by screws. Generally the body hole for the screws comes in the pattern plate, and it is made a little larger than the body of the screw. After the holes in the pattern are tapped out, the plate and the pattern are slipped back on the machine and located in correct position by lifting the carriage of the machine up and allowing the pattern to enter the stripping plate, then the screws are put in the bottom of the pattern plate and screwed up tight. The pattern and plate are then removed from the machine to the drill press and dowel-pin holes are made clear through the pattern plate into the pattern and dowel pins are driven in, thus preventing the excess of the diameter of the holes over that of the body of the

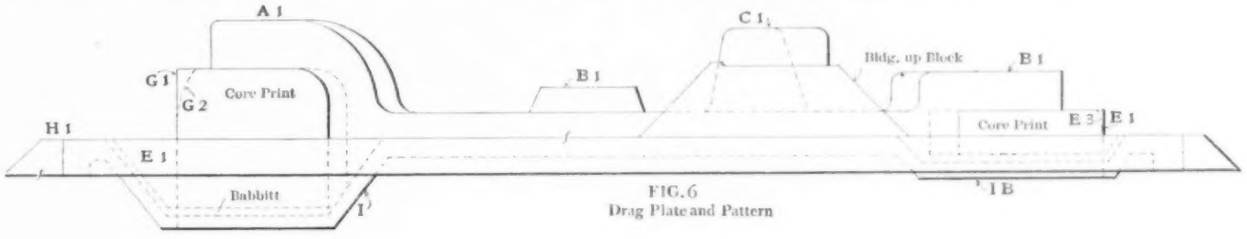


FIG. 6
Drag Plate and Pattern

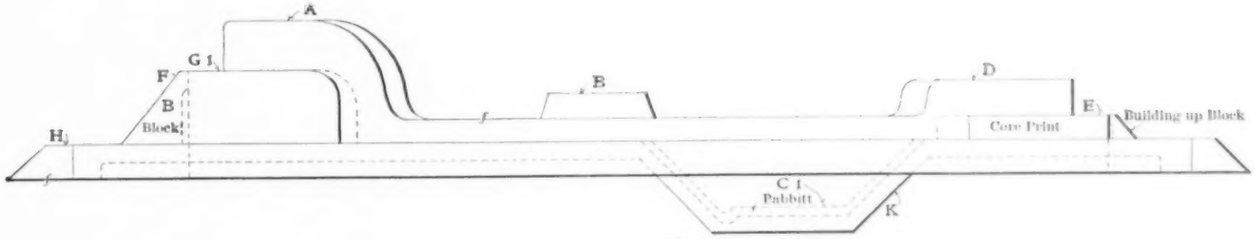


FIG. 7
Cope Plate and Pattern

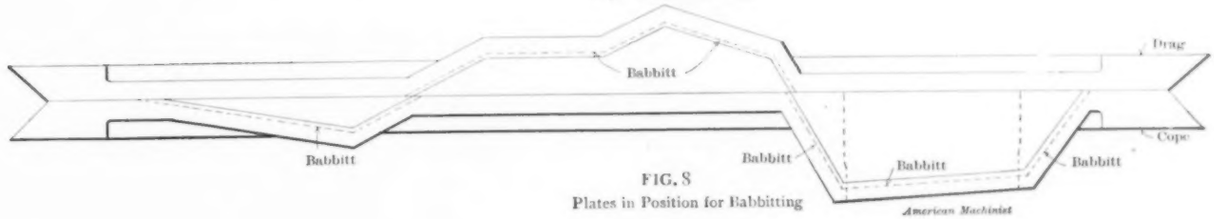


FIG. 8
Plates in Position for Babbitting

screws from causing the pattern to shift. The next step will be the babbitting of the two stripping plates, so the two plates must be prepared. This is done in several ways; sometimes by drilling several holes clear through the plates within the babbitted area and countersinking these holes from the rear. Another way will be to drill a lot of holes for small nails and then drive in the nails till their heads come close to the plate; the babbitt forms around these heads and is thus held firm. Another way is to drill a lot of holes part way through the plate and just let the babbitt run into them; this will go well where the holes are drilled at different angles, making a sort of a back draft and thus preventing the babbitt from coming out. The nail in the plates is the best method, and where a flexible shaft can be had with a drill on the end of it, it is a matter of a very short time to drill all the nail holes necessary. When the plates have been prepared for holding the babbitt, the two plates are clamped together, as will be seen in Fig. 8, and one plate at a time is poured. Each pocket to be poured should have a pouring hole of about ½ inch located at the most elevated point of the plate. When one plate has been completed, then turn the plates over and pour the other plate. Generally a pocket is built around the pouring holes with putty, so as to make the pouring easier and to keep a steady stream of babbitt running into the cavity till it is filled; and sometimes it is well to heat the plates a little before pouring; this will help the metal to flow up sharp in the thin places. Before pouring the two plates should be firmly clamped together so as to prevent them from swelling when the hot metal hits them, and if this is done there will be very little need of scraping the surfaces of the babbitt to allow the two planed surfaces of the plates to come together. I have known of instances where the patternmakers have spent nearly as much time scraping the two plates as it took to file and fit them to the machine, for in scraping them red lead is used and they are tried on one another as soon as the red spots are scraped off. While the babbitting is being done the hole in the building-up block for special screw device is plugged up with a piece of wood, so as to keep the babbitt from running out. When the babbitting is completed, the building-up piece with the special screw device must be fitted up, and then the block made fast again to the stripping plate. This then completes the fitting up of the patterns to the machines as I saw it in the foundry; another method that was suggested by the workman while the boss was studying the job, will be described further on.

The flask for this job was made of iron with trunnions on each end, as will be seen in the cut; all flasks were drilled with a jig and were thus interchangeable. As the pattern was long and narrow, a flask of similar shape, without bars, was used. A longitudinal section of the flask mounted on the machine can be seen in Figs. 2 and 3, while it can be seen in transverse section mounted on the drag machine in Fig. 5.

SECOND METHOD OF MOUNTING THE PATTERN.

In Figs. 6 and 7 this method is shown up. In mounting the pattern by this method the pattern is split on the lines *C*1 and *D*1 of Fig. 1, this line coming directly in the middle of the pattern, and one-half of the pattern is placed on one machine and the other half on the other machine. Fig. 6 shows the drag, which has a building-up block to reach up to the parting line on lug *C*1, which is on the lower corner of it; this leaves all of the pattern section *C*1 in the drag. The two forks on each end of the pattern must be cored out when made this way; as it is best to have the cores come in the drag, the prints for the cores come all on the drag machine and pattern and are designated by *G*1 and *E*1 of Fig. 6. By having all this core-print come in the drag, it makes a pocket *I* and *IB* in the stripping plate *H*1, Fig. 6. These pockets are babbitted to the building-up block on the cope machine *E* and *F* of Fig. 7. The cope section of the pattern is shown in Fig. 7, and is constituted of all not found in the drag machine or patterns. The same iron flask used for the first method will do for this method.

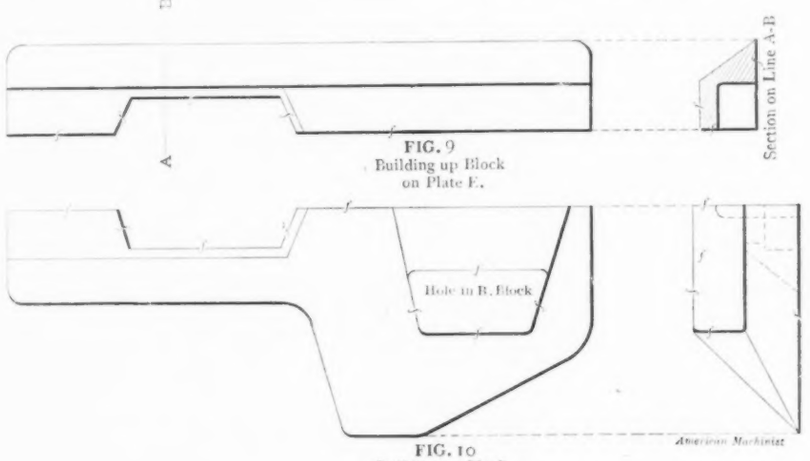


FIG. 9
Building up Block on Plate E.

FIG. 10
Building up Block on Plate F.

It is always advisable to avoid dry sand cores where possible, as there is so much danger of the operator damaging his mold when setting them. A good deal of danger can be overcome in the construction of the core and the core-print. For instance, in this case it will be noted that the core-prints *G*1 and *E*1, Fig. 6, are made with square corners, while the core *G*2 that sets in the mold is made slightly rounding from the parting line to the top of the drag, thus insuring the operator's getting it started in the opening made for it without tearing up the corners of the mold; there remains sufficient flat surface on the core on sides and bottom to insure its slipping in the correct position and staying there. The two plates are put together and babbitted, as was done with the plates in the first method. The first method is the preferable, as the dry-sand cores are done away with.

MAKING OF THE MOLD.

Two laborers work this job, one on the cope machine and the other on the drag machine; the length of time to make a mold on each machine is about the same, and as the men work together nicely, a good day's work is put up. An air hoist is employed to lift the flasks on the machines, as well as to lift the mold off, it being held and also rolled over by the trunnions. After the drag section is rammed up, the mold is lifted and rolled over and placed on the level floor; the cope is then placed on the cope machine and filled with heaped sand, rammed, struck off, and the pattern drawn by the crank on the end of the machine. The cope is then lifted from the machine and set on the drag, the pouring hole being made by a metal sprue placed in a small hole on the face of the pattern. When the mold or flask is clamped it is ready to pour.

A FEW REMARKS ON SHOP MANAGEMENT.

In connection with this foundry was a pattern shop well equipped with modern patternmaking machinery, for both wood and metal patterns, and there were employed in this shop several men mounting patterns on molding machines, principally of the draw-pattern stripping-plate type. While going through this plant I had the privilege of asking these pattern mounters what they thought of certain jobs that were running in the foundry, and I found that while the men always worked to the drawings furnished them, yet they had their own views as to how the jobs should be made. These men were always encour-

aged to give out their own opinions as to how the jobs should be mounted on machines; the head draftsman took note of these suggestions made by the men and made a study of them, taking the best according to his opinion and having his drawings made according to them. He told me that by this method he not only encouraged his men but really produced better results than any one man could give. The pattern mounters had the privilege of going to the foundry whenever they desired; in many plants this would not have been allowed for fear the men would have taken advantage of it, but in this particular foundry the management was A No. 1, and the boss was so liked that the men not naturally lazy took a great interest in their work, and even though they spent some time in the foundry they did a fair day's work. These patternmakers were paid as high as in any other shop, and in many instances received more money than most shops offered. In talking over pattern work with the superintendent he told me that years ago he was foreman of the pattern shop, and he made a study of the men who were under him. He had to put on new men occasionally when a rush of work came, and among these new hands he would get men that had worked in almost every pattern shop in that section of the country, some of them having the reputation of being pretty inferior workmen. He always started these new men on as simple work as he could find, so as to let them get used to him and the conditions of the shop before they spoilt any work; and in this way he found out just what kind of work they were accustomed to, and gave them as near that class of work as he could find. These new men soon learned to like him, and his influence over them developed to such an extent that they would stand for a calling down without becoming angry or excited in any manner, where in other shops if the boss gave them the same calling down they would speedily quit. These men, under a good boss, soon got over their tantrums and learned by practice to become valuable skilled mechanics, and promoted themselves out of the ranks of the loafer. If there were more such bosses as was this superintendent, there would be less trouble in the foundries and pattern shops.

Electric Traction for the Erie.

President Underwood, of the Erie Railroad, is quoted as saying that a committee is considering the question of electrical equipment for the road's suburban service, also for the section of the line between Susquehanna and Deposit, a distance of 15 miles, where the grades are heavy.

A recent English patent is that for an alarm designed to give warning when an injector becomes clogged and fails to operate. The alarm is a whistle, automatically sounded by the back pressure of the steam when the injector becomes inoperative.

Simple Steam Turbine Engines—I.*

BY JOHN RICHARDS.

I should perhaps apologize for presenting before the society a paper of so elementary a nature as the one that follows; but it may be assumed that such papers are directed to two objects—the advancement of technical knowledge among the members and the furnishing of popular information on technical subjects. The present paper belongs mainly in the second category. It is devoted to a subject so new at this time, in a popular way at least, that its elementary character will be an advantage, especially as the scientific phase of the subject has had copious treatment at the hands of others.

It is a strange fact that the "evolution" of steam turbines is following a course quite the opposite of that of piston engines. In the latter the constructive part was developed and in a great measure completed before the thermal or thermodynamic features were investigated and explained; and, as a matter of fact, ignoring the modern demands of increased speed and pressure, the constructive feature of such machines has not greatly advanced in recent times.

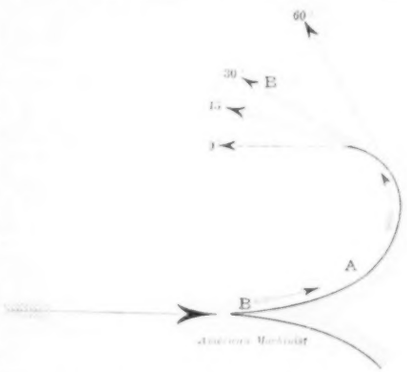


FIG. 1. SINGLE-STAGE TURBINES.

Some of Watt's steam engines remained in constant use for a century, and many old engines made in this country had a record of 50 years and more; but, as remarked, the thermal or thermodynamic features that pertain to the art have only in recent times become understood and applied. Thirty years past will include what may be called the scientific evolution of piston or pressure steam engines, and, with some exceptions, will include the development of their proportions and their arrangement into types.

In steam turbines the scientific part has preceded the constructive one; in fact, was complete in essential points when their practical construction and use began. This was, of course, because all steam and heat engines are governed by the same general laws, with the difference that turbine or impulsive engines deal with the flow and gravity of steam instead of its pressure, and hence are more complicated in several respects, but, as before remarked, they follow certain ascertained laws which govern heat engines in general.

The problem of constructing turbine engines has, as may be claimed, only begun. Even the types are not yet determined, and no doubt many years will elapse before this branch can reach a successful evolution and constant types appear. Design and methods of construction must arise out of use and experience, and must be proved by the inexorable tests of efficiency, endurance, adaptation, economy and cost.

A principal fact relating to turbine engines now in use is that while this term is applied to all kinds of steam wheels driven by impact, reaction, or pressure of steam there are two types that are quite distinct as articles of manufacture. One of these types I will call "single" acting, the other "stage" acting. These types are best known in common speech by the names of inventors who have in recent times been most prominent in their development; the single acting as the De Laval or Riedler type, the stage or double acting as the Parsons type. Another type, that will have some notice hereafter, is the reaction type, not commercially made at this time, but a "parent" of the whole, as will appear.

The two first-named types of engines are also designated as impulse and pressure machines, but these terms do not very clearly define just what is meant; they are, however, as nearly descriptive as any that can be selected for the purpose. The action to be described in these cases will be better understood by saying that one operates by "push" and the other by "blows." One is free running or open, the other inclosed to maintain pressure.

Of steam turbines, those of the stage or Parsons type are at this time the most numerous and the best known, and they have engrossed the thought and skill of many able engineers. They correspond in many respects to inclosed or pressure water turbines of the Jonval, Fourneyron and centripetal types, which act mainly by "push" or pressure, but not by sustained pressure in the same way as in the action of pistons.

The stage or successive action of the steam in this type of engines has for its main object the reduction of speed and rate of revolution, thereby adapting the machines for coupling directly to pumps, dynamos, marine screws and so on. It also avoids the enormous centrifugal strain set up in single-action machines.

Turbines of the single-action or impulsive type are open and without maintained pressure, as in the tangential, Girard and other unfilled water wheels. Consequently they have no running joints to maintain against steam pressure.

*Read before the Technical Society of the Pacific Coast.

Steam and water turbines being analogous in many of their features, and the latter being much better understood, especially on this coast, where water turbines of all kinds are employed, a comparison will aid in the present explanation.

The main distinction between steam and water turbines arises out of the different natures of the two fluids. One is elastic and light, the other inelastic and heavy. In the case of water the velocity of efflux is low and in proportion to its density, reaching a velocity of about 80 feet per second under a head of 100 feet, or a pressure of 43 pounds per square inch; but in steam the velocity is immensely greater. The velocity, in feet per second, of efflux from nozzles equals 60 times temperature in degrees Fahrenheit plus 460. This gives a velocity of 1,680 feet per second for steam at a pressure of 100 pounds per inch; but this is much less than is now assigned for actual efflux from nozzles on which the speed of turbines must be computed. The practical velocity of turbine wheels is computed on a flow of 3,000 to 4,000 feet per second, and for the vanes from 1,200 to 1,500 feet per second, or 75,000 to 100,000 feet per minute. This is more than 12 times the rate of the fastest railway trains, and, as a physical fact, almost evades the power of conception.

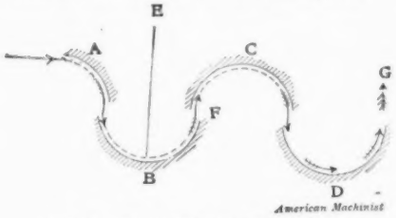


FIG. 2. MULTIPLE-STAGE TURBINE.

Otherwise than as to the great difference in their velocity, steam and water turbines follow like laws; the spouting energy, as it is called, being theoretically equal to the gravity; or, in other words, the "blow" is equal to the "push," provided the kinetic energy of the impact or blow can be equally utilized.

The action of all unconfined liquids is expressed in an old rule (it may even be called a gospel) of fluid motors: The fluid must "enter without shock and leave without velocity." This rule, applied to any motor driven by the impulsive energy of a fluid, will determine the correctness of the machine's operation, or, as it is called, its efficiency, meaning the useful effect produced in proportion to the weight and velocity of the fluid consumed.

To further explain this action of fluids, if a stream is directed against a fixed flat surface, only a portion of the energy is imparted to the surface; about one-half, in fact. The entry is a shock, and the fluid is scattered in a lateral direction with violence and leaves with velocity. If the same stream of fluid is directed tangentially into a curved vane or bucket, as in Fig. 1, and if its course is gradually reversed, it will leave with velocity, and that much of its energy will be lost; but if the bucket or vane *A* is set in motion with the fluid at one-half its velocity, then, by the component of these motions, the fluid will be brought to a state of rest, and will leave without velocity, the buckets receiving the total energy less fluid friction and some loss due to the divergence of the lines *B*. This is the manner of operating in all fluid motors of the impulse type or of single action.

The tangential entrance of the jet or stream and the resultant or discharge angle are very important features in practice, and will be again considered at some length, not in respect to economy alone, but as materially modifying construction in several ways.

Reverting now to the filled or pressure class of turbines for water or steam, these operate in a different manner, by what is commonly called pressure, but not pressure within the usual meaning of this term. "Obstructed flow" comes nearer describing the operation.

The course of the fluid through the machines is made so tortuous or difficult, by means of reversing or baffling curves or vanes, that the gravity or pressure of the fluid acts like a static force.

Fig. 2 illustrates, in an imperfect way, this action, the large arrow, in this as in other diagrams, being employed to show the line of impingement or course of the fluid.

If all the vanes or buckets, *A*, *B* and *C*, were fixed, it is clear that the water would be discharged at *G* with reduced velocity, even if it were confined; but if the vanes *B* are set in revolution in the plane at *E* at half the velocity of the water, it will be left at *F* in a state of rest or without velocity. If the vanes *B* are set in revolution at one-fourth the velocity of the water, there will be a residual discharge of force at *F*, to enter the third set of vanes *C*, these latter revolving in an opposite direction, so the speed of rotation of any set of moving vanes will be reduced accordingly. If the vanes *C* are fixed, and discharge into a fourth set of vanes *D* the rate of rotation can be reduced again as the square root of the water's velocity in the two cases. This is the manner in which the speed of stage turbines is reduced.

The vanes *A* and *B* may represent a common water turbine. With the vanes *C* fixed and those at *B* and *D* moving, we have a two-stage steam turbine, except that in all cases the buckets or vanes, whether for steam or water, are of ellipsoidal or other modified curves.

Water turbines of this class have commonly only two sets of buckets or vanes—*A* and *B*, for example—one fixed and the other movable. Stage steam turbines have from five to ten sets of vanes, the mobility of the fluid demanding this difference. All motors of this class are called "filled," the induction and eduction passages being approximately of the same size in the case of water wheels, but increased, of course, for elastic fluids to accommodate their expanded volume.

One other class of motors remains to be noticed, viz.: the reaction type. Their manner of operating will be more clearly explained later on.

These remarks will, I hope, explain the classes or types of steam-turbine motors as now made and in course of evolution; and, with this much respecting the principle or mode of their operation, I will turn briefly to their history and afterward discuss the constructive problems, which, as at first explained, form the principal theme to be dealt with at this time.

It is common to begin the history of steam engines with an account of the "æolipile," made in Egypt about 2,000 years ago, by Hero, a Roman architect. This device, with which almost every one is familiar, is illustrated by Fig. 3.

It is an organized steam motor, much better than some made at this day; and, considering the circumstances of the time, was a wonderful production, evincing, as it does, a knowledge of the expansive

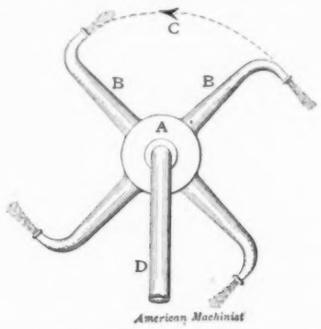


FIG. 3. HERO'S TURBINE.

force of steam; also the principle of reaction. *A* is a rotative steam-containing vessel, *B B* are hollow arms delivering jets of steam tangential to the path of revolution *C*. Supposing the vessel *A* to be filled with steam from a pipe *D* at a pressure of 100 pounds per square inch and the area of each jet to be 0.1 inch, or together 0.4 inch, then the pressure on these orifices, if closed, would be 40 pounds. When open, there is no pressure on this area, but an unbalanced back pressure of 40 pounds in the opposite direction, the turning force, due to reaction or unbalanced pressure.

I am aware that a mathematical treatment of this matter would involve the ponderable matter discharged, its velocity and other intricate conditions; but the theory of unbalanced pressure will answer for present explanation.

This Hero wheel was a reaction turbine, and, as such, was a much more complicated and ingenious conception than the direct-acting or impulsive wheel of Branca, which followed in 1629, about 800 years after Hero's æolipile.

This latter device can scarcely be considered an invention; but it must be re-

membered that the expansive force of steam was, even at that date, a mystery. No useful application of this device is known, and it was only a toy, consisting of a wheel with flat vanes against which a jet of steam impinged.

From this point the art seems confined to England, or mainly so, and from 1784 to 1901 there were granted in that country more than 400 patents for machines that may be classed as, or with, steam turbines. These various patents have been recently examined and listed by Robert M. Neilson, an engineer of Manchester, England, who has arranged a chronological list of them in a treatise on "Steam Turbines," published last year.

Even James Watt, John Ericsson, Perkins and other well-known steam engineers "had a try" at these obdurate machines without permanent result, and an inference, to be drawn from the copious array of schemes proposed, is that the principal impediments were in various operating conditions now better understood and mainly the want of resources for constructing machines to move at such great velocity.

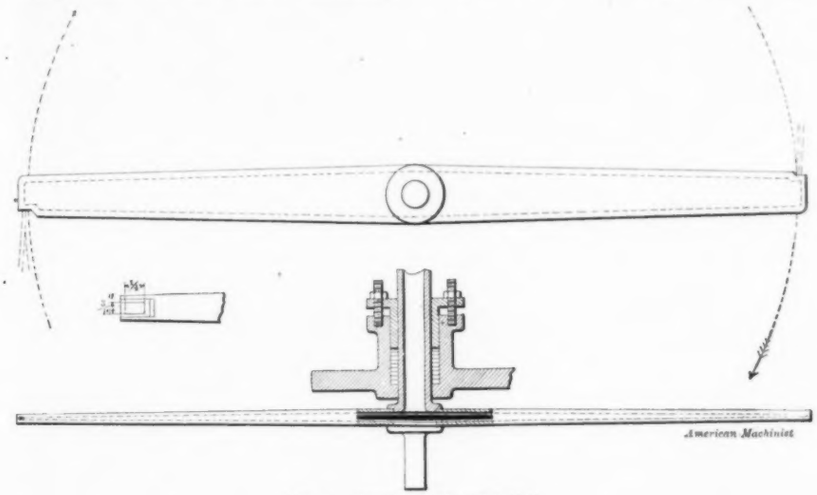


FIG. 4. THE AVERY TURBINE.

There is also the fact that, in so far as principles or modes of operating are concerned, these inventors anticipated about all that is known in the present steam-turbine practice, except in the respects just named.

Kemplein's engine of 1774 was a reaction one, with the arms and vents as in the æolipile of Hero. James Watt's machine of 1784 was similar in operation, with this difference, that he proposed to vent the steam under mercury or other fluid. Sadler, in 1791, devised a compound machine or one of double action, also of the reaction type. Trevethick, in 1819, proposed a reaction machine, and John Ericsson, in 1830, patented a very well designed reaction wheel.

In 1843 Pilbrow patented a stage turbine with a large number of fixed and moving vanes or buckets arranged for expansion. Indeed, his machine had all the main features of modern engines of the stage type.

In 1848 Robert Wilson patented the first radial-flow steam turbine, which in design fully anticipates the Dow and other radial-flow machines of our time. He also proposed a parallel-flow engine with expanding chambers or spaces, in the manner of Parsons.

In 1888 Alexander Morton, a well-known engineer of Glasgow, Scotland, made experiments with a steam turbine of ingenious form, and other inventors in Scotland made reaction machines that were said to be applied to practical work; but undoubtedly the principal part in the history of reaction engines was the invention of William Avery, of western New York, who, about 1825, made and put in successful operation a large number of such engines.

Mr. Avery was a near relative of Professor John E. Sweet, president of the Straight Line Engine Company, of Syracuse, N. Y., to whom I applied some time ago for information respecting the Avery engines. Professor Sweet replied as follows:

"In respect to the history of the Avery engines, these were made 75 to 80 years ago by William Avery, a local mechanic here. There were about fifty constructed and put in use. One of the runners is now in my possession; another, that I saw years ago, had a hollow shaft of perhaps 1¼-inch bore. The head or runner was of sword shape, the arm 1x3 inches at the center and ⅜x3½ inches at the ends, the diameter swept being about 5 feet. Steam was admitted through the shaft by means of a stuffing-box, passed through the shaft to the hollow arms and escaped at a tangential issue ⅛x¼inch, at the rear corners of each arm, the ends of which were stopped by plugs brazed in. Owing to the rapid rotation of the arms—10 to 15 miles per minute—the front edges were so rapidly cut away that replaceable blades made of tempered steel were inserted so they could be renewed. The fact that the engine had to be taken to a blacksmith shop every three or four months for renewal or repairs had more to do with their abandonment than their lack of economy. As to the latter, people who knew the facts, or claimed to do so, said that when they changed to the common slide-valve engines there was no gain in steam economy over the Avery engine.

"Another feature that worked against the Avery engine was the stuffing-box around the shaft, which, in the hands of workmen of that time, was apt to be set up so as to consume a large part of the power in friction. This was a natural consequence, as the wear was rapid. What the result would have been with a truly ground shaft in a metal bush, instead of a turned shaft and stuffing-box, making the issues expanding nozzles and multiple expanding by two or three arms in separate cases and connecting to a condenser, is not known. It might rival a pretty good modern engine, if not the best.

"The Avery engines were used in sawmills and woodworking shops of the time. They had weak starting power, and did not need much for the uses named. They ran at such a fearful speed that the reducing motion was an impediment. Mr. Avery had to employ bands, which were far more objectionable than gear wheels.

"The Ruthven and also the Gorman engines of the same type are mentioned by Professor Rankine in some of his writings and claimed as attaining an economy equal to piston engines of the time."

Professor Sweet sends, with his communication, a drawing of the Avery impeller in his possession. This is shown in Fig. 4, and it must be admitted that the circumstances described, as before remarked, form a principal fact in the history of free-running engines. The economy attained, even if there were no other fact than that of fifty or more engines being made and put into practical use, is enough to amaze one when it is considered that the engines were purely reactive ,like a Barker water wheel or the Hero engine in Fig. 3, and that the inert fluid under atmospheric pressure was left directly in the path of the impeller's arms, and wore away the front part where the pieces were inserted. The casing was no doubt of a form to prevent free revolution of the spent steam, otherwise this impediment would to a great extent have been avoided.

This machine admits of further comment, especially in its constructive features, and I have no hesitation in claiming that the material is in this case better disposed to resist centrifugal strain than in any steam turbine now being made. The speed was no doubt equal to that of machines now constructed. The structure is not exposed to incomputable inherent strains, as continuous wheels or disks must be, and the box section, made of thin metal plates, is the strongest known in the arts.

In a letter received from Charles Brown, of Basel, in 1903, I find the following remarks respecting the Avery engine:

"Early in the forties an American engineer by the name of Pratt told me that he had experimented with two of Avery's Hero reaction wheels, one with 100 pounds steam running at 45,000 feet per minute. It gave 30.3 horse-power and consumed 7½ pounds per horse-power hour, and another with 130 pounds steam giving 24½ horse-power consumed 6.16 pounds running at 54,000 feet. Diameter at nozzles, 5 feet. If these data are correct the result compares well with a 30 horse-power Laval, which, non-condensing, consumes fully as much coal as the old Avery. Pratt told me that Avery had built a locomotive with his wheel. Avery's engine had the advantage over the Laval that the number of revolutions, 2,800 to 3,600 per minute, are so low that it might be used for driving many machines without the intervention of gearing, so that it might be worth while to take up the study of the Avery again, for the wear and tear of the Laval gearings is heavy. For heavy work, the Parsons is not likely to be superseded for some time yet. Brown, Bouverie & Co. are crowded with orders, and the works are in a chronic state of expansion; the large sizes are so much more economical that the piston people have no chance. Latest tests gives 8 pounds per indicated horse-power hour."

The next step in practically applying the free-running steam wheel to useful purposes was, so far as I know, by Dr. De Laval, of Stockholm, Sweden. I was often in Sweden during the earlier experiments there, and imbibed a curiosity and interest in this matter that has lasted ever since, especially since coming in contact with the tangential type of water wheels on this coast. These latter are operated under pressures much greater than has been attempted with steam motors; that is, up to 900 pounds per inch, giving a velocity of 120 feet per second. I believe, and I shall attempt to show, that such wheels are made on a system much in advance of steam-turbine practice in some very important respects.

Following Dr. De Laval and perhaps others in steam-turbine wheels of single action, came a successful division into stages by Hon. A. C. Parsons, one of the most eminent steam engineers of our time. This subdivision, it may be called, of the steam turbines, had for a principal object, as before pointed out, a reduction of the speed of wheels and their adaptation to direct driving of dynamos, marine pumps, screws and the like, offering uniform resistance or load.

Wheels or engines of this type involve the maintenance of running steam joints between the stages, and demand workmanship that is now and will likely remain a bar to their general manufacture. There is also an inability to endure lateral stress on the spindles, because the running steam joints that separate the stages of pressure have a clearance of about 0.01 inch. These latter features have confined the engines to purposes where simple torque is delivered, but this includes a great part of the whole field of motive power.

Parsons's modification of these engines has called out scores of inventors and imitators in this and other countries, and it seemed for a time as though the De Laval engines were to remain sole representatives of the single-action system; but a reaction has begun, most notably in Germany, where Professor Riedler, the author of "Indikator Versuche auf Pumpen" and much other noted work, has, in conjunction with Professor Stumpf, produced single-action engines up to 2,000 horse-power, apparently of durable but expensive construction. I have drawings of these engines, accompanied by German text, with a list of engines in operation up to November of 1903.

There have been scores of abortive attempts in single-action machines, and no doubt there will be many more, because the problem, as a constructive one, offers a fertile field for the contriver incapable of understanding the impediments to be overcome.

The mechanical construction of machines should be approached by analysis of their operating conditions.

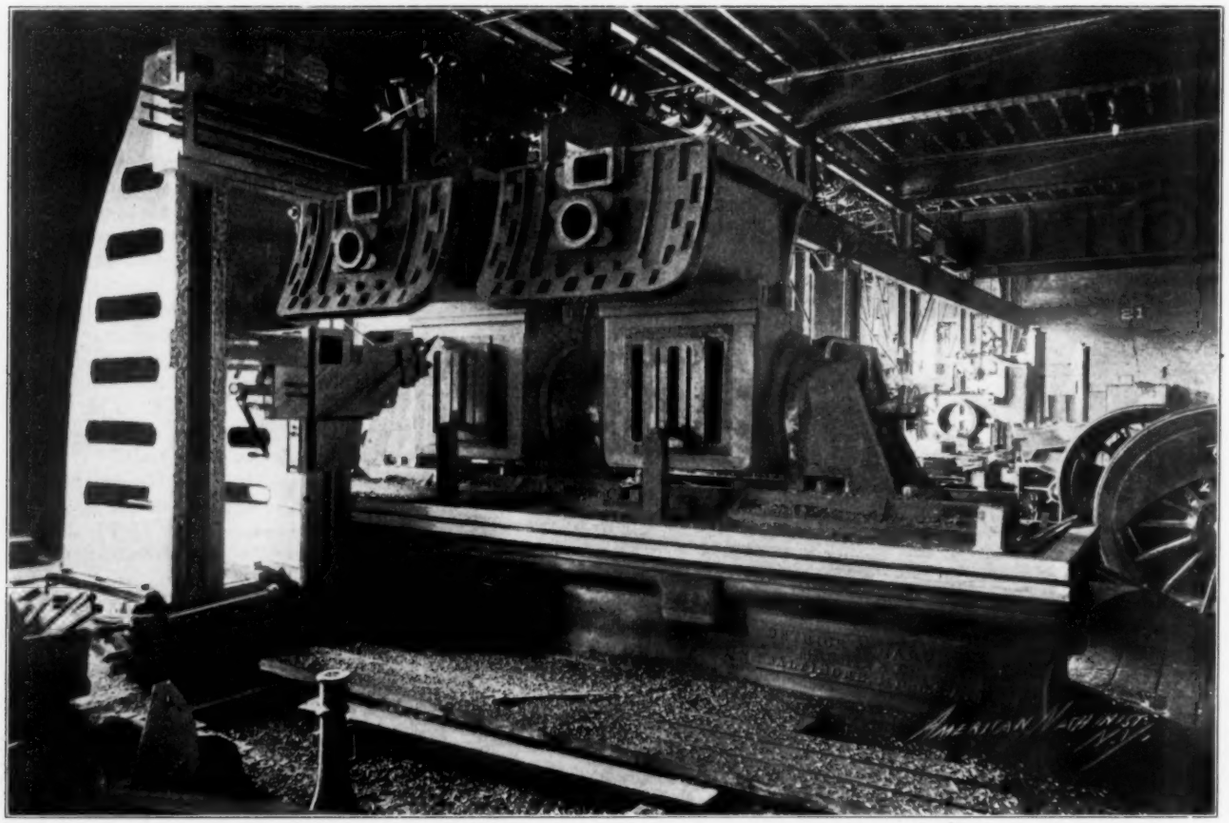


FIG. 1. SPECIAL PLANER FOR TAKING THREE SIMULTANEOUS CUTS.

These latter are not amenable to computation, except a few, such as the strength of material, normal strains, endurance or wear and so on; but beyond these things lie what may be called the "phenomena of operation," that must be learned by observation, inference, analogy, and, for the most part, empirically.

To illustrate what I mean: The generation of electric current by dynamos was a well-founded science long before there were durable and reliable journal bearings for the armature spindles, and these are now a survival from endless modification. The commercial factors of symmetry, cost, endurance and many other qualities belong in the same category and are not computable.

Aluminum *"bronzes"* contain 90-95 per cent. copper and 10 and 5 per cent. aluminum. The first fusion of 10-per-cent. aluminum is brittle. Re-melt several times. These aluminum bronzes expand in cooling, hence fill finest details of molds. They can be hammered till cooled off without flaws or cracks. Plunging into cold water makes them more ductile.

A hairdresser, as a rule, does a thriving business in combination locks.

Some Locomotive Shop Tools.

EDITORIAL CORRESPONDENCE.

Fig. 1 illustrates a novel and special planer for doing at a single setting the planing required on three surfaces of locomotive saddles. The planer shown is a Detrick & Harvey open-side machine, with the addition of an outboard housing and a special stake bolted to a cross-base piece on which it is adjustable and to the outboard housing. The work done by this stake is obvious from the illustration, and it is also obvious that, in the position of the work shown, the tool on the cross-rail is in position to plane the joint of the saddle half. A third tool, concealed by the work and carried by a side head on the farther or main housing planes a seat on that side of the saddle for the frame forging of the locomotive.

The supports of the saddle castings will be seen to provide for self-alining of the parts and to carry two saddle castings. This fixture is of the most substantial construction, a supplementary base plate being bolted to the planer platen with side ledges within which the centering supports slide. The cylinders are, of course, bored and faced before they come to this machine, conical centering pieces entering the counterbores and providing for a considerable range of sizes.

Figs. 2 and 3 illustrate fixtures for locating pedestal castings in the slotting machine, in order to divide the cut equally on both sides and around the crown. The base plate is fitted on its under side to drop directly into place, correctly centered on the slotting-machine table, and it has its two opposite sides, against one of which the workman is applying his rod gage, planed equidistant from its center. In Fig. 2 the workman is adjusting the casting, with its side parallel with the side of the base plate, and by applying the gage to the opposite side he will divide the cut so as to insure equal thickness in the two sides of the finished piece. He will next insert a stump in a hole provided in the center of the base piece, as shown in Fig. 3, and with a tram gage having a ball end fitting a cup in the top end of the stump, he will further adjust the casting to give a proper cut at the crown.

FIG. 2. FIXTURE FOR LOCATING PEDESTAL CASTINGS ON THE SLOTTING MACHINE.

Two of these fixtures are provided in order that one casting may be located in position while the other is being slotted.

The photographs are from the Richmond Locomotive Works. F. A. H.

The Kawasaki Dockyards.

A short while ago, it will be remembered, we published an article written by a Japanese correspondent, giving an account of the toolmaking department of the Kawasaki dockyards at Kobé, Japan. Our readers will be interested, perhaps, in an extract from a recent number of the *Daily Consular and Trade Reports*, pertaining to these dockyards and published under the heading of "Paternalism," although we are entirely unable to understand why this example of the enterprise of the Japanese government, and the sale of an established dockyard to a private concern, can be called paternalism, and we do not believe that it is properly so called. The extract is as follows:

Started by the Imperial government as a government dockyard, it was sold to Mr. Shozo Kawasaki in 1886, and comprised 9 acres of land, within whose limits were located two patent slips and the necessary buildings. To-day the yards cover over 40 acres of land, with a frontage along almost the whole length of the west shore of Kobé harbor. In 1896 the Kawasaki Dockyard Company (Limited) was incorporated with a capitalization of $2,000,000, in shares of 50 yen ($25). This is held by 129 stockholders, who receive a regular 12 per cent. dividend upon their holdings. Ships ranging from 1,000 to 8,000 tons can be built simultaneously. Two more shipbuilding berths are under construction for ships of not less than 20,000 tons.

Besides a fine graving dock over 425 feet in length, the construction of which involved an expenditure of $800,000, the yard is equipped with the best machinery obtainable from the most advanced models throughout the world, the most expensive one being a boring machine purchased in America at $25,000. Electricity, steam and water power are all used in the works. It contains up-to-date tool shops, carpenter, boiler, blacksmith, and coppersmith shops, and is about to add punching and machine, slab-bending and forging shops. The foundry is equipped with four cupolas, with capacities of 2, 3, 5, and 8 tons, respectively. Two powerful 20-ton overhead traveling cranes, controlled by electricity, and two 5-ton electric cranes are also in the foundry. A projectile shop for the manufacture of projectiles is a feature of importance, though somewhat unusual in a dockyard equipment. There is also under construction an erecting shop, which will contain 40- and 20-ton electric overhead traveling cranes. At present this plant is working day and night.

The New York Central—New Haven Electrification.

The recent announcement that the New York, New Haven & Hartford Railroad is going to operate its trains in the "electrical zone" in the neighborhood of New York City by single-phase alternating-current locomotives, has called out from Frank J. Sprague an article, published in the *Street Railway Journal*, which considers at length the difficulties which are likely to arise and the drawbacks to the employment of this system, in view of the fact that the same terminal yards and tracks for several miles are used by the New Haven road and the New York Central & Hudson River Railroad, the latter company having, as is well known, planned all its equipment for operation by direct current (at a potential of 650 volts at the third rail), and having had for a good while one locomotive built and in operation on an experimental track. Mr. Sprague concedes the possible advantages of the new system *per se*, but raises numerous objections to its adoption in the present case. It is to be presumed that these objections have already been considered by the engineers of the New Haven, and a statement by them of the opposing considerations would be very interesting.

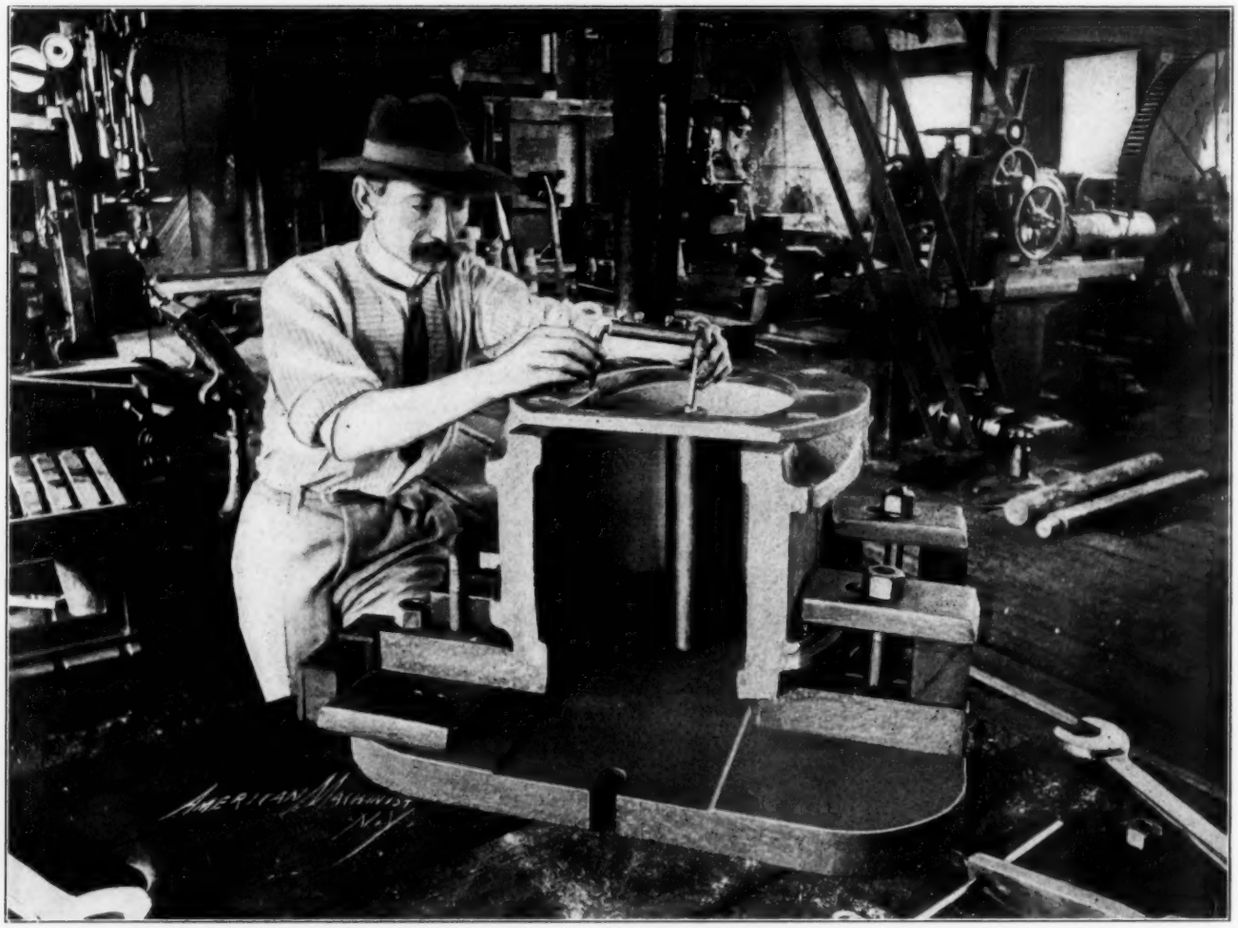


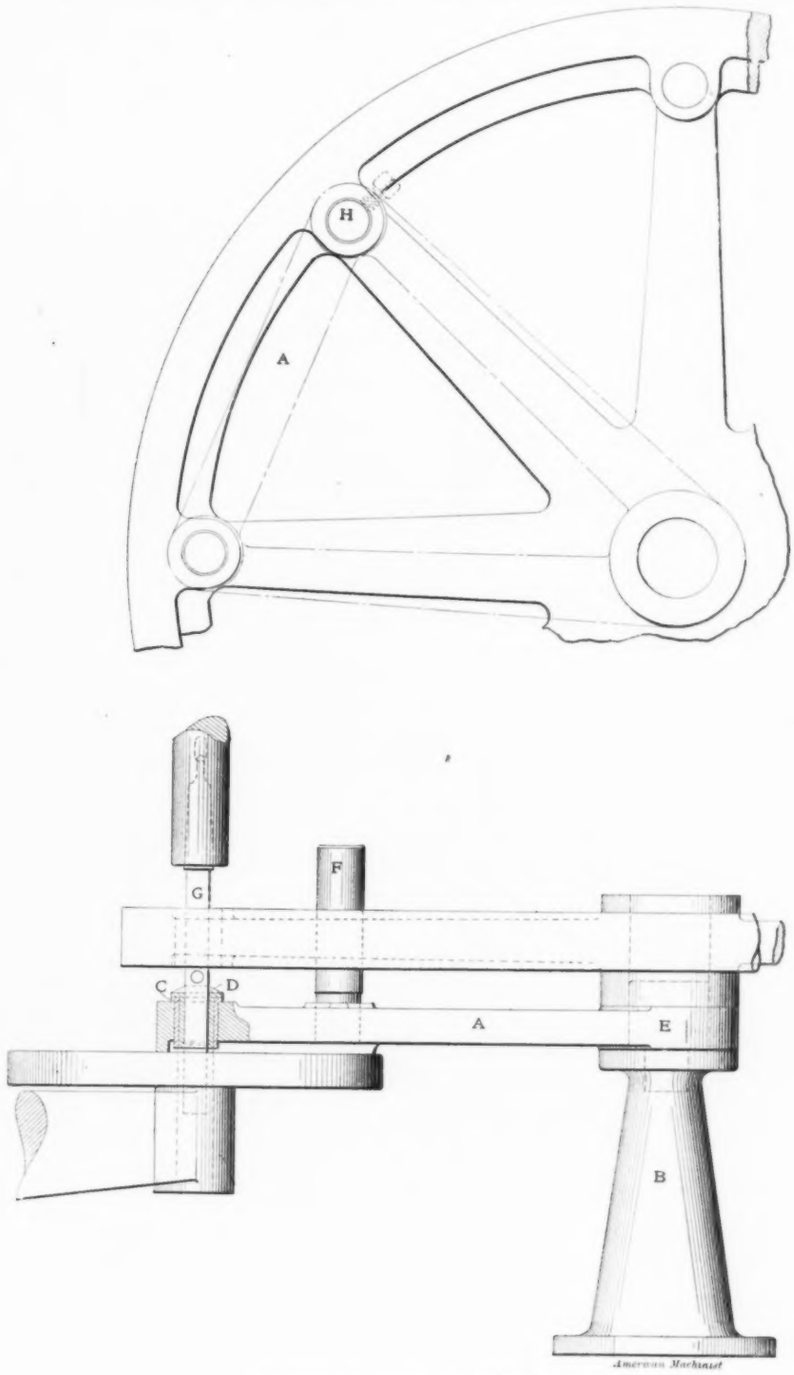
FIG. 3. FIXTURE FOR LOCATING PEDESTAL CASTINGS ON THE SLOTTING MACHINE.

A Novel Method of Original Indexing.

We are building some large machines, each of which contains three 72-inch gears, a part of one of which is shown in the accompanying illustration. There are cored holes in the rim, which must be finished 3 inches diameter, parallel with the center hole and 45 degrees apart. These holes are on a 31-inch radius, and are required to be accurately spaced.

As there are eight holes to be bored in the gear rim, and the number of teeth in the gear is a multiple of eight, we expected to use the teeth as an aid in spacing the holes; but on inspecting the teeth after they were cut, it was found that the variation in spacing was too great to permit of their being used as a guide for the holes, and the following method was decided upon:

A 30-inch drill press was the most suitable machine we had for the job. A pattern was made and a casting gotten out for a jig of triangular form, the outline which is shown by the broken lines in the plan and at *A* in the elevation. The bosses at each corner of the jig are finished flush by planing, and there is a finished pad extending down and resting on the drill-press table.



AN ORIGINAL INDEXING METHOD.

The hole corresponding to the center hole of the gear was bored and the jig mounted on column *B*, which is a casting faced on top and having a hole finished for the centering plug *E*, which also fits the hole in the jig and the bore of the gear. The column was carefully leveled and located the correct distance from the center of the drill-press spindle and bolted to the floor. The distance between the holes to be bored in the rim (or their chord pitch) was calculated and laid off on the jig with a tram having fine points, and the spacing holes were bored to these lines. The jig was left fastened to the drill-press table after the second spacing hole was finished, and a steel bushing *C*, hardened and ground, forced into the hole. Bushing *D*, in which the boring bar *C* slides, was also hardened and ground, and made a running fit in *C*. It has a feather in its bore, by which it is driven from the boring bar, and a collar screwed on its lower end prevents it from lifting when the boring bar is withdrawn. The boring bar has a taper shank fitting the drill-press spindle.

The gear was mounted on top of the jig, with its center located by plug *E*, and the first hole bored, after which the gear was swung around to bring the bored hole in line with hole *H* in the jig, when a plug *F*, which is a nice fit in both the gear and the jig, was inserted, thus locating the work for boring the second hole, and this operation was repeated until eight holes were bored.

We bored the holes in the first gear 2⅞ inches diameter, or ⅛ inch small, to test our jig, as we expected some error in the jig which would accumulate in spacing the gear, showing up between the first and last hole, and it was there—0.11 inch—showing that the holes in the jig were spaced about .0015 inch too far apart. To make the correction, a new plug *F* was made, this time to 3 inch diameter, to fit the hole in the gear after boring to size; but its lower end, where it entered the jig, was reduced .003 inch in diameter, or .0015 inch was taken from each side. A set-screw was then put in the jig, so as to bear against *F* and force it against side of hole toward the boring bar, thus bringing the holes in the gear .0015 inch nearer together, and on completion no difference could be detected by calipering between first and last hole or any other two holes.

M. B. F.

An alienist, testifying a few days ago as to the sanity of a certain person, replied to a question in which there were 15,000 words, his reply being that the man was insane. We often receive questions of not more than ten words, which we cannot answer, and if we should receive one of 15,000 words, no alienist would be required to find evidences of insanity.

Making a Clutch Coupling on the Molding Machine.

BY GEORGE BUCHANAN.

When setting up a molding machine for castings similar to Fig. 1, several important points should be considered. (It is of course understood that a sufficient number of castings are required to warrant the expense incurred in setting up the machine.) The first important point to be considered in the setting up of the "clutch casting" is the obtaining of the requisite number of duplicate patterns—in the present instance, four. As the clutch teeth are used in the machine for which they are made without any fitting, it is of the first importance that there be absolutely no variation in the four patterns. Having obtained the clutch-teeth patterns, a set is molded in the ordinary way, and the four castings thus obtained are tried into their matching parts, in every way possible, in order to detect any error. Too much stress cannot be put on the importance of the points just considered, as in many cases the parts have to be made some months before they are assembled, and if a large number of parts have to be scrapped, we have not only to replace the castings, but we have lost the time expended on them in the machine shop, and more important still is the often irretrievable delay in the delivery of the machines.

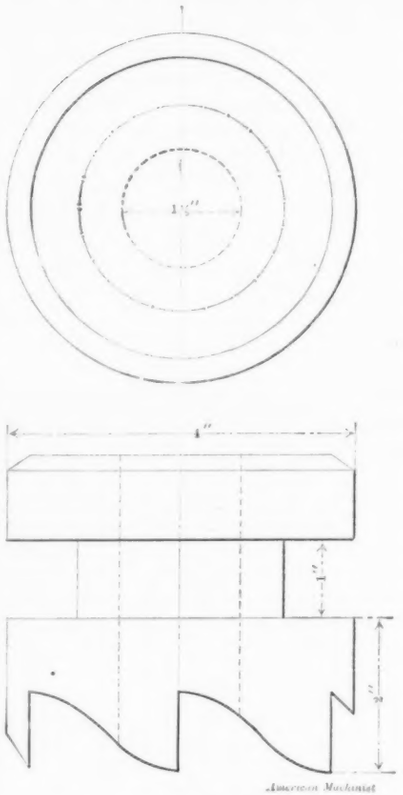


FIG. 1. THE CLUTCH TO BE MADE.

The allowance for boring the hole and turning the recess in the clutch is considerably reduced when using the machine, and the diameter of the casting made on the machine is not quite as large as when made by hand, the difference in size being due to the rapping of the pattern when made by hand. The depth of the casting made by hand is also affected in the same way as the diameter when the patterns are of metal—the rapping necessary to loosen the pattern causes it to sink a little deeper in the mold. This is much more noticeable when the patterns used are heavy.

Another important feature is, that patterns mounted on the machine can be quickly and easily taken off and others replaced, as it is seldom convenient to have a machine for every set of patterns. The method employed in fixing the clutch pattern is fairly simple, and only one machine is used for the three parts, which are required to make a complete mold.

Figs. 2 and 3 are plan and side views of the head of a stripping plate molding machine. *S* is the stripping plate, in which three sets of holes are shown, through which three sets of patterns project—a set for each part of the mold. *D* is the pattern plate for the drag part. The hole in the clutch is stooled, and is shown in section on the side view at *E*. *M* is for the middle part, and is a loose plate having two pins projecting from its

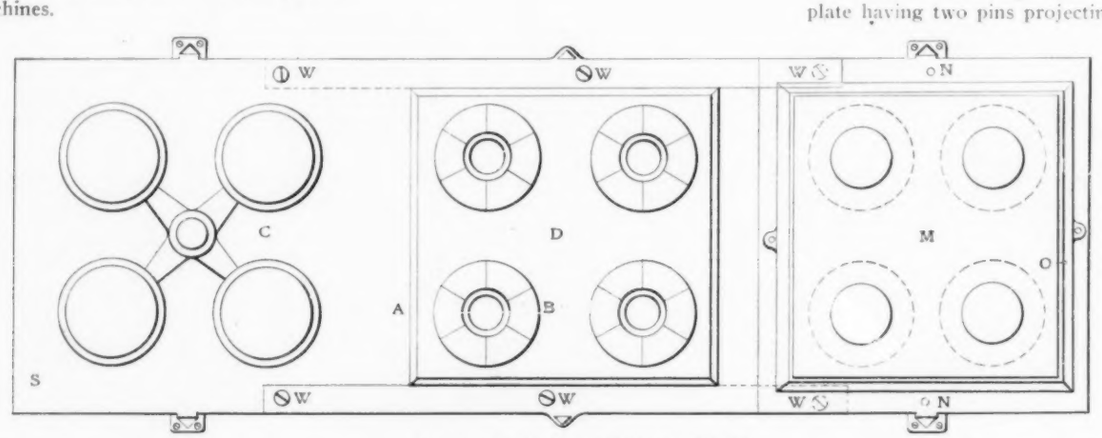


FIG. 2. PLAN OF MOLDING MACHINE.

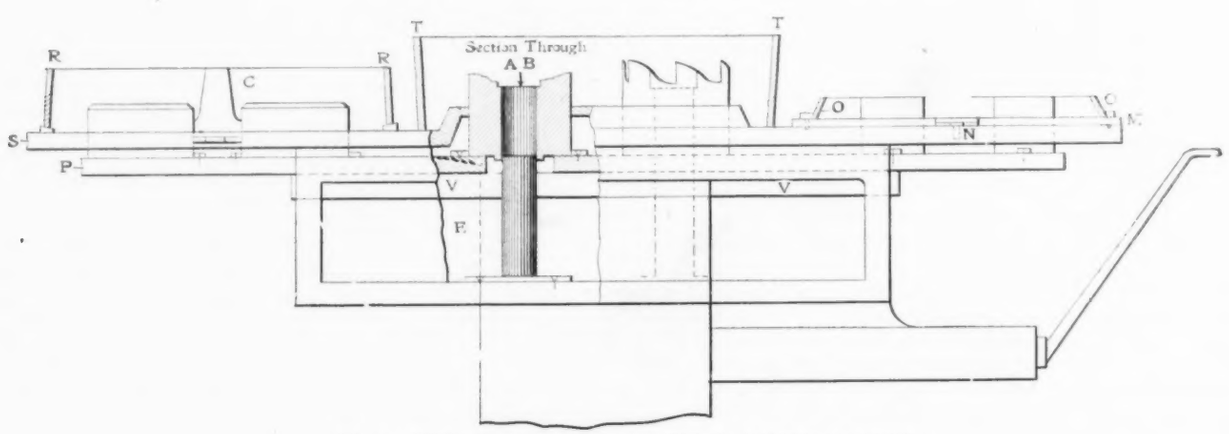


FIG. 3. ELEVATION AND PART OF SECTION OF MOLDING MACHINE.

back, fitting suitable holes in the stripping plate *S*. The position of these holes is at *N*. The ring *O* is also located on the plate *M*, and is shown in section on the side view. *C* is the pattern and plate on which the cope is rammed; the runners are also fixed to this part of the stripping plate. The flask used is a taper flask, and is in two parts only; it is shown in section at *R* and *T*, in Fig. 3. The plate *P* carries the three sets of patterns, and is located by dowels and bolted to the pattern-carrier *V*. A turn of the handle lowers or raises all three sets of patterns. The stripping plate is a gray-iron casting, machined and carefully laid out for the twelve 4-inch holes through which the patterns project. Adjustable guides are provided by which to locate the flask parts, and the plate is held firmly on to the machine stand by six set-screws *W*.

MOLDING.

To make a mold the flask parts are located as in Fig. 3. The facing sand is first tucked into the four holes in the drag part and a sprig pushed down until it butts on the stool; a vent wire is placed by the side of the nail. The three parts are now rammed up and struck off level with the flask tops, the middle part *M*

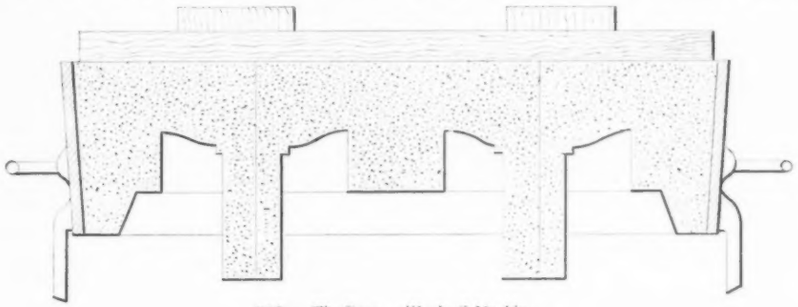


FIG. 4 The Drag as lifted off Machine.

FIG. 5 The Middle Part.

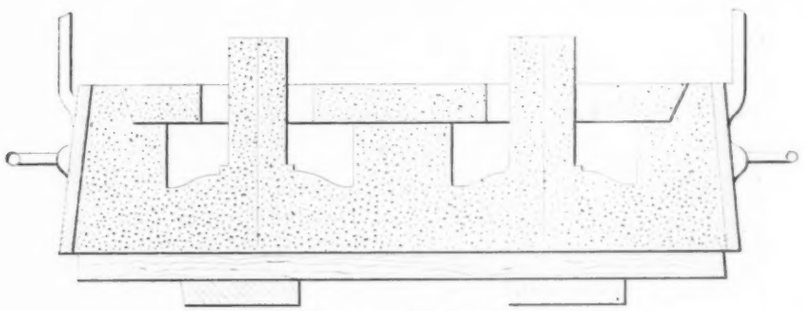


FIG. 6 Drag and Middle Together.

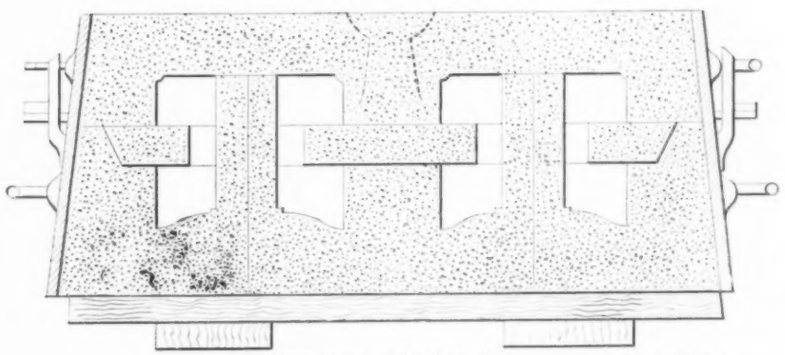


FIG. 7 Section of Mold Complete. *American Machinist*

receiving more attention, so that a smooth surface is obtained.

The lever is now turned, and the ring *O* on the middle part removed. The drag is next lifted off and placed on to the middle part. Fig. 4 is a section of the drag lifted off the machine, and Fig. 5 is the middle part. The two parts being placed together and turned over and the plate *M* lifted off, leaves the mold as shown in Fig. 6. The cope is now lifted off the machine and placed on the drag, leaving a complete mold, as shown in Fig. 7. Figs. 8 and 9 show mold ready for pouring, the flask having been removed and the slip *X* slipped on and the weight *Y* placed on the top. The saving in labor expected on this piece is about 80 per cent., with the additional advantage due to really duplicate castings.

Echoes From the Oil Country—The Waste Basket as a Source of Mechanical Information.

While it was the machinist that I had in mind when I wrote about the value of reading the advertisements, I am glad to see that their value seems to be fully appreciated by some of the draftsmen also. In the letter from England that is signed "Trochee," it is made clear that it takes the advertisements to round out the knowledge obtainable from the AMERICAN MACHINIST.

I can see how this would be especially so in his case, as in them he would be able largely to follow the trend of practice in this country, and to see wherein it differed most from that where he is. When he speaks in another letter ("Some Reasons Why Good Men are Scarce") about the failure of some capable men in not taking advantage of the opportunities which come to them, and by which they are surrounded, I think I can see in them the kind of men who cannot get value from the advertisements.

Sometimes I get very much discouraged about this matter of self-education, and really when it is sifted down I think that self-education is the only kind that amounts to much. Now, my friend, don't stop right here and get ready to pitch into me; rather, wait a minute and get at my meaning. The self-education that I have in mind is the kind that a fellow wants to get. If I study mathematics because I know that my business demands that I increase my knowledge of it, and I am interested in my business, I get hungry for it even though my mathematical talent is naturally below par.

I don't want a lot of theoretical frills, but I do want the practical part of it. Now, my idea of "self-education" is the kind that is acquired because the person getting it, for some reason or other, wants to get it. When a boy gets a gun, his first idea is to learn to shoot with it. By and by he may want to go into the theory of the matter and know "why," but with a live boy, that comes afterward if at all, and lots of good hunters have very hazy ideas about the real "why."

When a boy, or a man, is studying fractions in a way that will stick into him forever, he has a use for them and wants a knowledge of them that he can put into his work. That is self-education. It is the kind of education that becomes part of one's self, and the only way to get it is to want to get it, and not because you

want to get an "education" in an indefinite sort of a way because "it is the thing to do," but because you want that particular part of an education for some specific reason. No matter *where* you get it.

My discouragement comes from the fact that I find so many fellows who want more education than they have only because they think it will get them a better job, which in their minds means less work and more pay. It is not because they feel that they could do better just where they are if they had it, but because they feel that they want the boss's job, and in some way feel that all they need to be fitted for it is to get a little more "education." Information would be a better name for what they really get. It becomes real education only when it becomes part of one's self, so that it is used.

I believe that most firms in this country have numbers of periodicals which accumulate around their offices and which they would be glad to give to any of their men who showed any real desire for them. These usually have a bearing on the business in which the firm is engaged, and should be of interest to any man who is working for them, and who wants to get up in the business. If you are one of those who think that success is in getting farther and farther from manual labor, don't be too inquisitive when you are where someone has used these periodicals as a nucleous for a sort of shop library. It is pleasant to keep some ideals from the mutilating hand of fact. But there are some men and boys who do want this information and there is lots of it for them. There is one other source of supply that I have never seen mentioned. It is the humble waste basket. How many times have I thrown circulars, pamphlets and catalogues into the waste basket with a feeling that it was a shame that they could not be put to a better use. Here often was boiled down information of the most practical type, for it is in such things that the advertiser follows up what he began in the paper. Often, when reading a book on some subject, the mind is bewildered in trying to get the practical and the essential separated from the historic and the speculative, so as to be able to make use of it, but, in a circular, space is too precious. Business men know that they will not wade through much trash (trash to a busy man at a busy time) in such things, and so to obtain a hearing such matter is cut down to the solid meat. When it comes to making some kind of an apparatus work as it is intended to work there is no place to go for information where it can be had with as much clearness as in the printed matter sent out by the manufacturer. It would almost seem as though it were a technical mechancial education that was being thrown into the waste basket, and just because there is no hand stretched out to take it and make use of it.

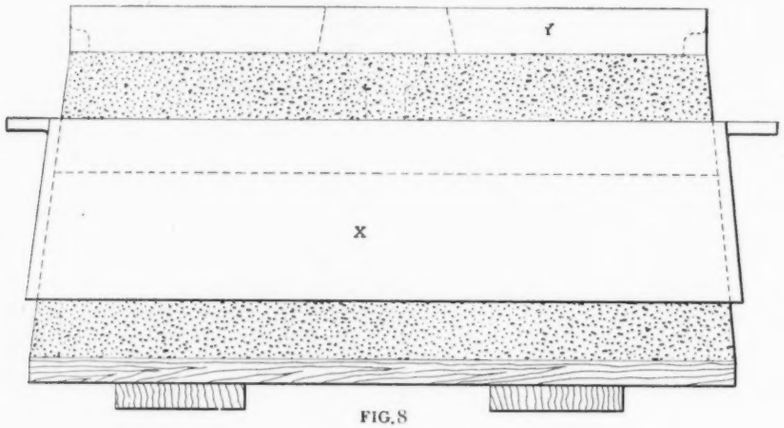


FIG. 8

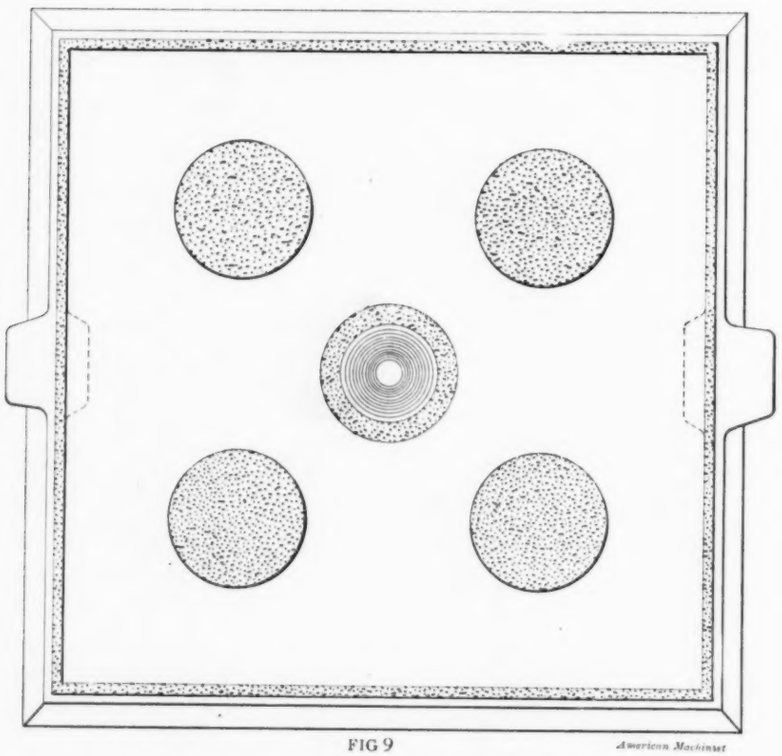


FIG 9

MAKING A CLUTCH COUPLING ON THE MOLDING MACHINE.

Sammy knew a whole lot about pumps, but all he knew about injectors was that they were contrivances for putting water into boilers, and from the comments he had heard some of the men make who knew less than he did on the subject, he had formed the idea that they were very unreliable kind of things. As Sammy did not know anything about them, perhaps you may doubt there being any men who knew less on the subject than he did, but as all the information some of them had was erroneous, it should be counted the same as a negative quantity is in algebra, and that is less than nothing, so that no knowledge should count for more than erroneous information, and certainly it is likely to do less harm.

One evening the foreman said to Sammy, "Go to the livery stable and get a rig and go over to West Spring Creek and put on this injector. Take a joint of pipe, some fittings, and the pipe-cutter and dies. You will get there about dark and will find that they are just shutting down at the sawmill. It will be a short job to get it on. Be sure you leave everything in good shape before you leave. Have the boss see it. I guess you can manage to get supper at the boarding house."

Sammy was a comparatively new man in that shop and had been doing his best to get a good reputation. He was a young man and felt that he needed it, so he did not like to tell how ignorant he really was about injectors, but he started away with

some misgivings. This one was a Hancock inspirator, and, fortunately for him, the box it came from the factory in was also given to him, and in that box was a little book that told how to operate it. The road was rough and hilly, and Sammy let the horse walk while he studied the book, and memorized the instructions as to which way to manipulate the handles to work the thing. After he felt he had them learned, he went to reading about the things that could go wrong and prevent proper working. At first it seemed to him as though there was quite a lot of them, but after a while it struck him that with a new machine the trouble was likely to be that either it did not get the water or else it did not get the steam, and he felt better.

At the mill he found that they wanted the injector set in a very awkward place, where it was hard to work a pipe wrench, but fortunately the lift was not much, although it was quite a distance horizontally. When he got the connections made and tried to get it to throw water it refused to work, and Sammy felt miserable. He wished someone else had been sent out on that job. He had overheard the owner of the mill grumbling about the shop sending a "kid" out on the job. "I'll give them fellows to understand that when I send for a man and pay him I expect to have him. Bill says that kind of an injector isn't any good, anyway (Bill was the man who ran the engine and did the firing and it was well to have him favorable to the things in his charge). If we hadn't needed it so bad I would never have let him start to put it in." There was a lot more, and it showed Sammy that not only himself, but the shop and the injector were on trial, and not before the most impartial judge, either.

He was sure that he had blown all of the chips out of the steam pipe before attaching the injector, and it seemed to him that he had all of the suction pipe tight, as he had bleeding knuckles to show that he was pulling hard when the wrench slipped off, but thinking over the causes of trouble given in the book, he was led to go over that pipe very carefully. It seemed to him that the union by which the suction pipe was connected was not up square, or at least that the pipe did not exactly line with the injector. He disconnected it and wiped it off carefully (it was a ground joint) and put it together again, holding it as near in line as he could while screwing it up and screwing it as tightly as he could. On the next trial he had the pleasure of hearing the first real hum that told him that it was working. That was the first time that he had ever heard that noise. After knowing what it meant it was music to him, just as a nice sounding exhaust was. The owner and the engineer had to start it a good many times before they were satisfied that it was all right, and as Sammy saw that it went every time, his courage revived enough to allow him to tell of its superior points. He had read about them in the book. He gave them to understand that if there was any trouble it would be their own fault, as they had a very superior machine, and it had been set up by a good mechanic. Sammy drove home in the dark and thought a lot on the way back about the kind of information he got from the little book. He found there was a lot of it going into the waste basket and he put some of it to good use.

W. OSBORNE.

A Large Pattern Storage Building.

EDITORIAL CORRESPONDENCE.

The Brown Hoisting Machinery Company, of Cleveland, Ohio, has recently completed a pattern storage building that is noteworthy, not only because of its size, but also because of the very complete arrangement for hoisting and distributing the patterns. The building is in six sections, of which two are shown in the plan Fig. 1, fire-walls being built between the sections. In plan each section measures 59 feet by 28 feet 5 inches, with a height of 36 feet under the crane runways.

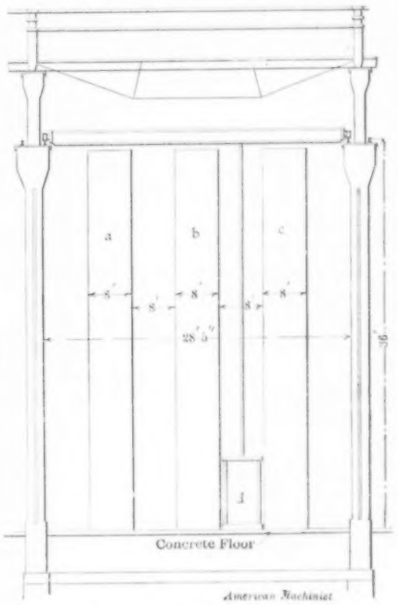


FIG. 2. VERTICAL SECTION.

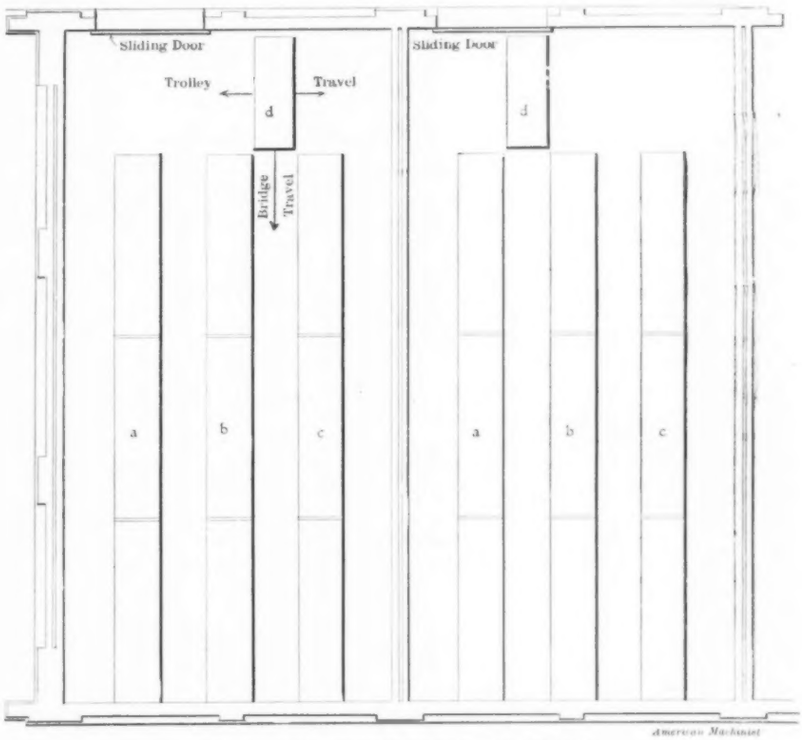


FIG. 1. PLAN SECTION OF PATTERN STORAGE.

Each section has three racks *a b c*, Figs. 1 and 2, eight feet wide and extending as high as possible, and have the crane girder pass over them, as indicated in Fig. 2. The racks do not reach the front end of the building sections and have aisles between them in which a platform *d* may pass, the space at the end of the racks being sufficient for the transfer of the platform from one aisle to another. The platform is hung from a crane of which the runway rails are supported by the division walls between the sections of the building.

It is obvious that, the patterns being loaded on the platform in the front of the building, it may then be hoisted to the level of any shelf, be traversed to any aisle and then be run down the aisle to any point desired, and that the same facility obtains in removing the patterns.

F. A. H.

Letters to the Editor.

Rotating a Shaft 180 Degrees Without a Dead Center.

At page 123 of AMERICAN MACHINIST, current volume, William Osterhom presents a design for rotating a shaft 180 degrees without a dead point. This was published without editorial comment.

At page 257, Carl J. Ulmann criticizes the sketches and description of Mr. Osterhom, with the result that an editorial comment appended to Mr. Ulmann's article conceded the fallible character of Mr. Osterhom's design, explaining that attachment of the rod *c* by two links to two cranks set 90 degrees apart will cause the links and cranks to move as one solid piece with the rod *c*, the mechanism will be the equivalent of a single crank with the rod pinned directly to it, and that "there is no doing away with the dead center, after all."

I had supposed the matter to be finally settled, and thought no more about it until I saw a communication, signed "Strawboss," on page 308, in which he states that he made a model of cardboard, pins and lead pencil for shaft, which works precisely as stated by Mr. Osterhom, and my attention was further challenged by the editorial comment appended to the communication, which confirms the possibility of the movement.

Mr. Ulmann is right from his point of view. As I understand him, he denies the possibility that rod *c* can reciprocate longitudinally at all in line with itself in a construction such as is shown by Mr. Osterhom. Nevertheless, movement is possible, as stated by "Strawboss," when the rod *c* is allowed to oscillate in a vertical plane. I, like Mr. Ulmann, understood, when first reading Mr. Osterhom's rather imperfect description, and inspecting his still more imperfect sketch of the device, that the intention was to move the rod *c* in line with itself; and there is nothing in the description or drawings to indicate the movement of this rod. I think most readers would make the same assumption. Accordingly, I did not think the device operative.

Being led by the statement of "Strawboss" to make a further study of the device, I have found an analysis of the movement more interesting than I anticipated, and I believe this analysis will be interesting to many readers of the AMERICAN MACHINIST, some of whom may wish to extend it further than I have, and to work out the equation of the curve traced by the extremity of the bar *c*, as shown in Fig. 4 of drawings herewith supplied.

The device, while interesting as a kinematical study, is, in my judgment, of little value in practical mechanics. There are other simple and much more compact ways of rotating a shaft first in one direction and then in the other through any number of degrees of arc without a dead point. But as I think the statement that this motion has no dead point is inaccurate, I will discuss this claim. In the sense that at the end of the oscillation through the 180-degree arc, power applied in the proper direction will immediately reverse the motion, it has no dead point; but this is not what is meant by the term "dead point."

Fig. 1, in the accompanying drawing, is a plan view of the device, the cranks *e* and *a* being drawn unduly thick, so that the eye can more readily differentiate them from links *b* and *d* and the rod *c*. In the diagram, Fig. 2, the bar *c*, links *b* and *d* and axes *g* and *g'* of the crank-pins, all lie in one horizontal plane, and are, therefore, mechanically regarded, all in line with each other. The cranks *e* and *a* being fast to the shaft *S*, form, with the

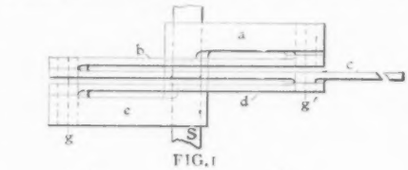


FIG. 1

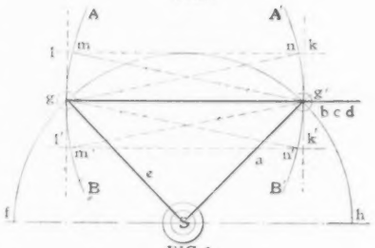


FIG. 2

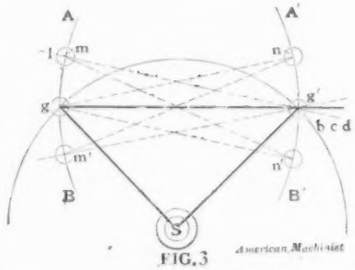


FIG. 3

ROTATING A SHAFT 180 DEGREES WITHOUT A DEAD CENTER.—LEICESTER ALLEN.

shaft, a bent link, whose longest dimension is *g g'*, Fig. 2, in length equal to that part of the distance of the bar *c*, measured from the axis *g* to the axis *g'*. The whole device, therefore, kinematically reduces to a system of linkage, comprising the link *a e*, link *c*, link *b* and link *d*, all of equal length between the centers of their bearings in the horizontal plane; *c*, however, being indefinitely extended to the right, and link *a e* being rigidly connected with the shaft *S*, around the axis of which it must rotate in any movement of the system. The following is the definition of *"Dead Center"* and its synonym *"Dead Point,"* contributed by the late Professor R. H. Thurston to "The Century Dictionary":

"In mechanics, that position of the arms of a link motion in which they coincide with the line of centers—that is, when the links are in the same straight line."

Under the warrant of this authoritative definition, I am justified in asserting that in the position shown in Fig. 2, all the links are on a dead point, or, rather, are each on two dead centers *g'* and *g'*; so that, instead of doing away with a dead point, there are two dead points. The link *b*, by any parallel movement of bar *c*, cannot be caused to take any horizontal position, as *k l*, above the line *g g'*, Figs. 2 and 3, while rotating about the axis *g'* on the circle *A B*, Fig. 2, because the link *d* would then rotate with *g* as center, on the circle *A' B'*, to take the position *g n*, also above the line *g g'*; and this would involve the shortening of the bar *c* by compression to an amount equal to the difference between the respective lengths of the line *g g'* and the line *m n*, which is impossible. Similarly, it may be demonstrated that no parallel movement of bar *c* can cause link *b* to take any position *g' l'* below the line *g g'*. Moreover, bar *c* can never take any parallel positions as *l k* or *l' k'*, either above or below the line *g g'*, because this would involve the lifting or lowering of the shaft *S*, which is fixed. Again, if simple pull or push be applied to bar *c* in the direction of its length, it cannot move, because such movement would cause link *b* to take some position *l g'*, Fig. 3, above, or *m' g'* below the line *g g'*, while the link *d* would simultaneously take the position *g n'* below, or the position *g n* above the line *g g'*, which is not possible except by revolving cranks *a* and *b*, and this would immediately move bar *b* out of line with *g g*, which is contrary to the hypothesis.

We thus, by a process of what the geometers call *"reductio ad absurdum,"* prove that the bar *c* can never move parallel to itself, neither upward nor downward, nor on the line *g g'*. The system works only when bar *c* is oscillated in a vertical plane by operating upon its extension to the right of *g'*, *thus prying the links out of line with each other*, and thus moving them from off the dead points which they occupy when in positions shown in Figs. 1 and 2. If we should extend an arm from the crank end of the connecting rod of a steam engine and force it up or down when on either of its dead centers, we should be doing the same thing.

Having thus discussed the claim for elimination of the dead point and shown it to be baseless, let us now see whether the movement of bar *c* is similar to that of the hook-rod of the Corliss valve-gear. The hook-rod, referred to, when in action moves both of its ends in arcs of circles. The bar *c* of Mr. Osterhom's device moves only one end in that way. This will be seen plainly by inspection of Fig. 4. This shows for one 90-degree arc nine different positions of cranks *a* and *e*, links *b* and *d* and bar *c*. The consecutive positions of crank *e* are shown by *dotted* lines; the correlated positions of the crank

a are shown by *thick* lines; the correlated positions of the link *b* are shown in *dot-and-dash* lines, and the correlated positions of bar *c* are shown by *thin* lines. These correlated positions are numbered in the direction of rotation 1 to 9 inclusive. We will call arc *Q R* the first quadrant (it technically is not in trigonometrical usage, but is so styled here for convenience only) and the arc *R V* the second quadrant. The direction of rotation is indicated by the arrow. From *V* as center and with radius $V R = g g'$ is drawn the arc *R P*. The crank positions correspond with extremities of equal arcs each of 11¼ degrees. *Q R V* is the circle described by the crank-pin center. The left-end center of link *d* being coincident permanently with the crank-pin of *e* (see Fig. 1) must traverse the crank-pin circle. The right end of link *b*, being similarly connected to crank *a*, must also traverse the crank-pin circle. The right end center of link *d*, being pivoted to bar *c*, must follow the pivot center over whatever path this center describes. Assuming that this path is the arc *R P* (there may also be other paths) whenever the left end of bar *c* is at any of the numbered positions in what I have called the first quadrant, the position of the center of its right-hand pivot will be on the arc *P R* and may be found for the numbered positions by taking any one of the points 1, 2, 3, etc., in the first quadrant as center, and with *g g'*, Fig. 1, as radius and describing small arcs cutting the path *P R* at points 1, 2, 3, etc., on that path. It will be seen that for the assumed path *R P* the positions of bar *c* correspond both with these points and the centers from which the small arcs are drawn, and the same is true for any point intermediate between the numbered points. Moreover, as the link *d* is straight, and as "a straight line is the shortest distance between two points," this link, during the movement of crank *e* through the quadrant *Q R* must coincide with the position of the bar *c*, and hence parts of the thin lines lying to the left of *R P* and representing the positions of bar *c*, also represent the positions of the link *d*. Also it will be seen that the center of the left end of link *b*, being pivoted to the bar *c* must follow the path of its pivot center, and we have already seen that this path is the arc *Q R*. The right end of the link *b* being connected to crank *a*, must follow the path of the center of its crank-pin over the arc *R V*. Therefore, the dot-and-dash lines drawn from points 1, 2, 3, etc., in the arc *Q R*, to correspondingly numbered points in the arc *R V*, indicate the several positions of link *b* during the movement. Of course, when the movement is reversed, and the crank *e* passes the point *Q*, the position of link *b* will correspond with the position of the bar *c*, while the link *d* will take angular positions in relation to this bar.

Finally, if any point *T*, Fig. 4, be taken in the bar *c* and, with radius *R T* and centers 1, 2, 3, etc., on the path *R P*, small arcs be described cutting the thin lines representing different positions of the bar *c*, and if the points of intersection be joined by a curve *T W*, this curve is the locus of the point *T* during the movement. Without working out its equation, which I have not done, it is of course impossible to classify this curve; but from mere inspection it seems much like a parabolic spiral. I submit that no point or points in the hood-rod of a Corliss valve-gear describes such a curve. The only analogy between bar *c* and the hook-rod is that both oscillate in a vertical plane. The hook-rod does not partake of the nature of a lever and has no fulcrum. Bar *c* is a lever, as well as a link, the pivots by which it is connected to the links *b* and *d* being each a fulcrum alternately. Regarded as a lever, the amplitude of the motion of its actuating arm is so great that I think it might as well be bolted directly to the crank arms.

LEICESTER ALLEN.

To the man up a tree, it looks like a bunch of errors. Mr. Osterhom is certainly wrong in saying that the connecting rod *c* should be rigid, but with that corrected it is a good working mechanism, and is something more than a combination of two connecting rods and cranks acting at different angles, inasmuch as the rod is jointed, or connected to the cranks, not directly, but by links, which permit equal and like movement of the two cranks. Nor is the mechanism, on the other hand, the equivalent of a single connecting rod and crank, since neither link moves as one solid piece with its crank or the connecting rod throughout, but each link moves relatively to its crank during one-half the movement, and relatively to the connecting rod during the other half, and there is no dead center, for the force, whether of push or pull, is always applied far outside the center line of the shaft.

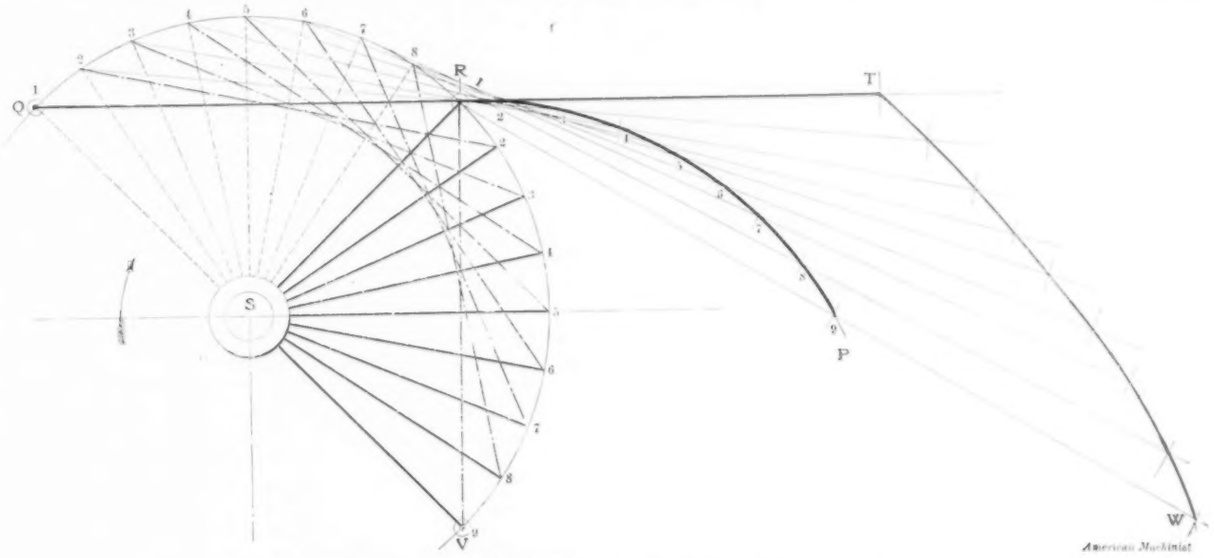


FIG. 4. ROTATING A SHAFT 180 DEGREES WITHOUT A DEAD CENTER.—LEICESTER ALLEN.

Assuming the initial position as at Fig. 1, rod *c* moving to the right revolves crank *a* by means of link *b*, *e* being keyed to the same shaft as *a*; link *d*, connecting *c* and *c*, moves idly during the first quadrant; *h* moves on the same circumferential path as the crank-pins, causing rise and fall of rod *c*. At the stage of Fig. 2, link *d* and crank *e* become the working members, crank *a* and link *b* moving idly while being carried through the second quadrant to the position of Fig. 3. From position 2 to 3 also the movement of *h* is lessened, and *g* travels in the crank-pin path; thus the rise and fall of rod *c* is less than during the first quadrant. It is obvious that these movements will be retraced when the travel of rod *c* is reversed.

It may be noted that the linkage shown in Fig. 4, having a link *f* inserted be-

tween *c* and *b*, would permit of connecting rod *c* being held to a straight line reciprocating motion. C. W. PITMAN.

Philadelphia, Pa.

The comment of Strawboss upon my criticism of Mr. Osterhom's article being justified, I have to thank him for drawing attention to the error. It is excusable, I think, since the description originally given is not very clear.

The arrangement, Fig. 1, would act precisely as Mr. Osterhom's mechanism is intended to. This may not be as good, but is simpler and shows the principle at a glance.

I have now also made a model of the original device, and find, of course, it may act if the driving rod is permitted to swivel, a condition my original criticism did not take into account. But this construction leaves the driving rod in the middle position free to act on either crank, and it depends on the comparative friction of the crank-pins or other uncertain causes which one will be acted on. If the wrong one, it leads to end positions like Figs. 2 and 3, and therefore would defeat the desired end. The defect is overcome by adding lugs on the two arms of the bell crank, which prevent the short connecting rods from moving inward. (Fig. 4.)

The model I send you has this lug on the one arm of the bell crank, and not on the other. You will see that the movement always acts correctly on the side which has the lug, and goes wrong just as often as right on the other side.

C. J. ULMANN.

[At Mr. Ulmann's suggestion we submitted the foregoing communication to Strawboss before publishing it, and the comments of the latter are presented herewith.—ED.]

In response to your communication, with Mr. Ulmann's letter and sketches enclosed, I would say that I had already discovered the difficulty which he points out, but the remedy is so simple and obvious that I did not deem it worthy of a special letter. His device shown in Fig. 1 would work perfectly at low speeds, but would be apt to be noisy and tend to "get off the hooks" as the speed increased.

The device shown in his Fig. 4 would also be noisy unless there was a cushion of some kind provided to take the shock.

I had intended to make a practical model of the device, but have been unable so far to find the time; however, it would seem safe to say that simply turning the rig the other side up and letting the weight of the "hook rod" and connections decide upon the right crank at the right time would do away with all difficulty of operating it. STRAWBOSS.

The consideration and discussion of Mr. Osterhom's device for rotating a crank 180 degrees without a dead center has, I think, been a little befogged for want of a layout showing successive positions of the parts during the cycle of movements. Models are very well to give a general idea of the motion, but usually in a case of this kind one does not feel warranted, unless he is an instructor in a technical school, or an engineer or machinist actually contemplating the use of the device, in taking the time and trouble necessary to insure in the model sufficient accuracy, absence of lost motion, and completeness to enable the motions of the different parts to be determined with precision. I have made a skeleton layout which I present herewith, and which I think will be of some assistance in studying this interesting bit of linkage.

The 180 degrees has been divided into 16 parts, giving 17 positions, including the first and the last. The 17 positions of crank *a* are shown by heavy full lines, and the positions of crank *e* which are not hidden by these are shown by dotted lines. The rod *c*, as has already been stated in the AMERICAN MACHINIST, must, in order to allow the device to work, rise and fall like the hook-rod of a Corliss engine valve-gear—but with this important modification: Any given point in the valve-motion rod moves back and forth through one arc of a circle, whereas a point on the rod *c*, as soon as it has completed one arc, immediately starts on another arc just like the first, but described from another center and intersecting the first; when it has finished the second arc, it retraces its motion over the two arcs successively to the starting point.

This will be apparent from an examination of the diagram. Starting with the rod *c* at the extreme left of its motion, the link *d*, shown by dotted lines, extends vertically downward to the pin of crank *e*; the center line of link *b* coincides with that of the rod *c*, which it continues to do during the first 90 degrees of rotation of the shaft. During the second 90 degrees, from position 9 to position 17, it is the link *d* which coincides with the rod *c* and, and we get no more dotted lines representing its positions; whereas, directly after mid-position the link *b* separates itself from the rod (except of course at the pin-connection) and takes the positions shown by the full lines. I will not take space here to elaborately follow out all the stages, for I think the explanatory notes on the drawing and the numbers on the different points, all like numbers corresponding to the same position of the mechanism, will enable this to be readily done.

If provision be made to allow the outer or right-hand end of the rod *c* to follow the double-arc path shown, this rod will

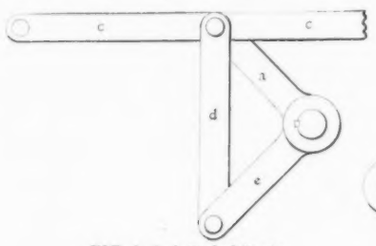


FIG. 1 Left End of Stroke

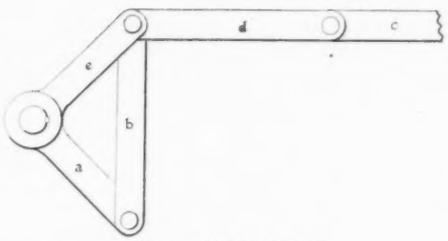


FIG. 3 Right End of Stroke

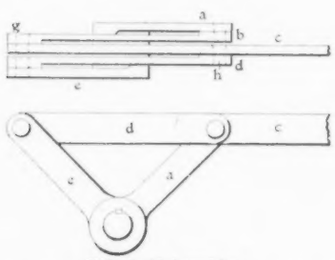


FIG. 2 Mid-position

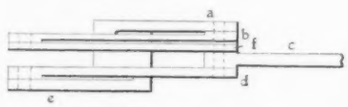


FIG. 4

American Machinist

ROTATING A SHAFT 180 DEGREES WITHOUT A DEAD CENTER.—C. W. PITMAN.

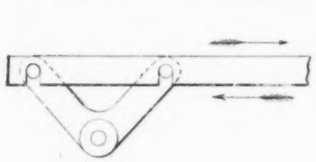


FIG. 1

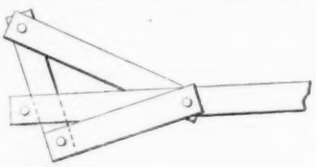


FIG. 2

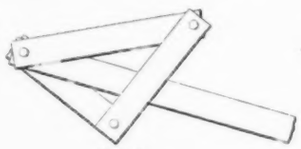


FIG. 3

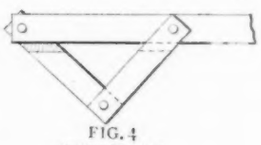


FIG. 4

American Machinist

ROTATING A SHAFT 180 DEGREES WITHOUT A DEAD CENTER.—C. J. ULMANN.

always move parallel to itself, and, alternately pulling and pushing on the rod in a horizontal direction, will cause the mechanism to be operated all right. Before I perceived that the outer end of the rod should be guided in this path, I thought that the motion was impracticable because I pictured to myself the outer end of the rod describing awkward gyrations of undefined form, and no doubt it would do this if not restrained. But, for that matter, we restrain the end of the connecting rod of a steam engine by means of the crosshead and guides. The question of the best means of supporting the outer end of the rod *c* is another story; it will of course depend somewhat upon the nature of the machine and the source from which the power for driving the rod is derived—whether, for example, from a reciprocating slide, a revolving wheel, a cam, or a rocking lever. H. J. KENNEDY.

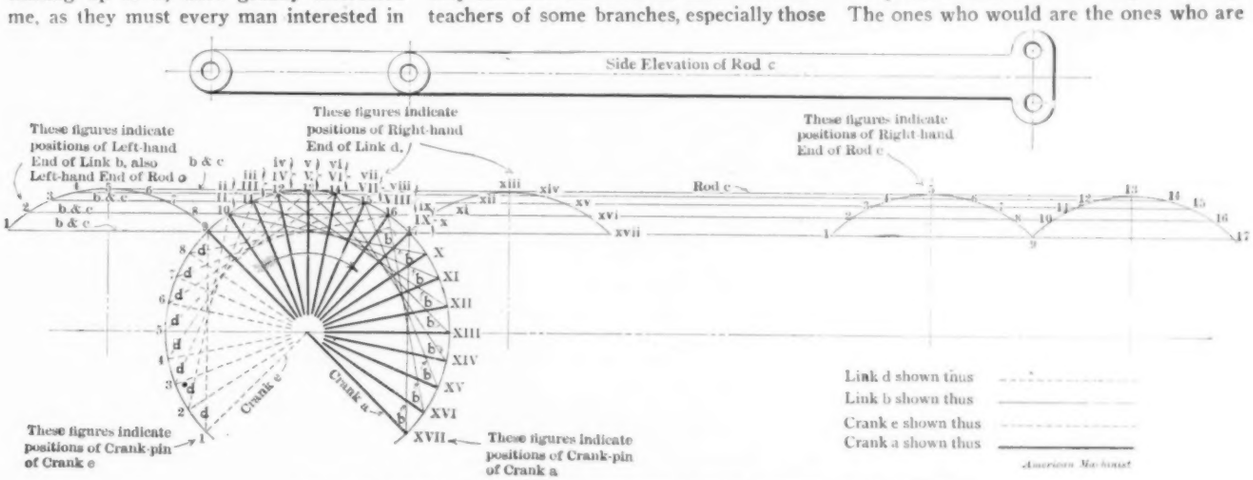
Technical Education for Shop Men.

The editorial at page 542, and the paper leading up to it, have greatly interested me, as they must every man interested in the education of engineers and workmen. However, I fear that when it is attempted to put either of these plans into actual use there will be one or two points which must be met and threshed out before much is accomplished. First, we have the fact that technical schools are highly organized bodies, giving regular courses, which courses are what university men deem the best possible to offer. To ask that students be admitted to these courses without the same book preparation that these men already demand, is to produce about the same effect as to ask that a machine, slightly differing from the standard, be built in a highly specialized shop. The result is a cost out of all proportion to the result obtained. I mistrust, considering that technical education is so largely controlled by non-technical men, that it will be impossible to get an opening for students whose preparatory education has been partly taken in the shop, unless separate courses are established, which would be very expensive.

Then, too, if boys come in from outside, they will be dubbed "greasy mechanics" by their associates, and either hazed or shunned, one being as bad as the other. In fact, human nature being rampant in our youth, they will be driven out. They can no more mix with the preparatory schoolboy than oil with water. The only opening that the writer sees is an entirely separate school or an entire change of some existing school. The latter is improbable, since the graduates of any school have a perfect right to a strong influence on the school after they graduate, looking to the preservation of the value of their degree. If, then, a separate school is to be established, it would naturally be under the control of the employers of the boys attending it. This would undoubtedly be a grand, good step in the right direction, as I believe that no one who has not done things himself and had control of men should teach or direct the teaching of engineering or of trades. If these employers are to establish a school, possibly they can draw on the local universities for teachers of some branches, especially those whose object is culture and pure mathematics, and in that way economize. Then, too, if such a school is started, it would undoubtedly occur to these employers that they might further economize by having directly connected with the school a shop into which they could turn all their apprentices, under the management of some good man, who could organize and control the boys, doing the work which they would put them on in their own shops. Then we would have, at probably as little cost to the employers as now, a school turning out men who are capable of doing good work and of thinking and planning. Only one trouble can be expected, as I see it, and that is that if care is not taken the boys will get too exalted an idea of their abilities and be discontented in the positions they are capable of holding. But if it is firmly impressed that only those who show unmistakable ability will be allowed to go ahead to the study of engineering, and that the rest must not expect to pass the grade of workmen or foremen unless they can work their way up through the shops, then everything will probably work out well. I have been told that it is doubtful if a boy can learn a trade, learn from books, and earn a living all at once; but till I see it disproved, I shall believe that he can. That is, a picked crowd of boys, under enthusiastic leadership, will, in my opinion, do as much work as their strength will allow. To-day, the opening for a boy with nothing back of him and a burden to carry, is discouraging, even if he is ambitious and willing to work. Almost any boy with a few dollars ahead, or a friend, can enter a technical school, and while the latter seldom graduate more than half those that enter, I believe that very few who have grit and a serious intention of going through, fail to do so. They do not all occupy positions of great renown, nor are they all doing pure engineering work; but they are doing well enough to encourage others to try.

These boys would not be satisfied with the position that comes through the shop. The ones who would are the ones who are too poor or have too heavy a burden to carry to aim so high, and from these boys I believe must come our future native supply of skilled men, and through just such a school. Whether employers will see that this will be merely giving "a square deal for every man," or whether they will wait till they are forced to it by a famine of skilled labor, remains yet to be seen. "ENTROPY."

[That the plan which our correspondent criticizes would lead to some expense, goes without saying; but, then, all education is expensive. That new schools could be organized and conducted at a saving over the plan of utilizing existing schools, we do not, however, believe. That some adaptation of the curriculum to the school work already done by the boys would be necessary, also goes without saying, and, we take it, that this is recognized in the proposed extension of the course at the University of Cincinnati to five years. The manner in which the new class of students would be received by the others


Side Elevation of Rod c
These figures indicate positions of Left-hand End of Link b, also Left-hand End of Rod e
These figures indicate positions of Right-hand End of Link d.
These figures indicate positions of Right-hand End of Rod c
Rod c
Crank e
Crank a
These figures indicate positions of Crank-pin of Crank e
These figures indicate positions of Crank-pin of Crank a
Link d shown thus
Link b shown thus
Crank e shown thus
Crank a shown thus
American Machinist

ROTATING A SHAFT 180 DEGREES WITHOUT A DEAD CENTER.—H. J. KENNEDY.

is no doubt largely a matter of locality. Before the entrance requirements in existing schools were raised to a height which stopped it, there was a liberal sprinkling of men from the shops among their students, who, if anything, were looked up to rather than down upon by their fellows; and at some of our universities, especially the Western State universities, the spirit of the students is still finely democratic. At Cornell, for example, it is quite the fashionable thing for students to go to their university work carrying their luncheon in a tin dinner bucket—a fact which speaks volumes for their good sense. While there are exceptions, we think that there are few places where a man so surely finds his level and is rated at his true worth as the American higher institutions of learning.—ED.]

Indicating Machinists' Dimension on Drawings.

Some eighteen years ago I went into a Western drawing office which was following the Pratt & Whitney "Instructions to Draftsmen," putting on all dimensions and a letter *f* on the finish lines. After about two years of this system I changed to another office where "Chordals Code" was the rule and where dimensions were put on finished parts only, or if it was necessary to dimension from a rough surface, it was marked *rough*. No other dimensions than those indicating finished surfaces were given.

While these two systems differ very materially there are some commendable features in each. For several years I regarded the two systems as different from each other as oil from water, and was sure they would not mix. But more recently I have learned of a way to combine and get all the advantages of each on one drawing. This system consists in using two thickness of paper for the tracing instead of one, as is the common practice. See Figs. 1 and 2.

Take a piece of tracing paper (or cloth) double the size required for the tracing and draw a pencil line through the center. Make the tracing on one-half, putting on dimension lines for all dimensions, but with the pattern figures omitted, then fold the sheet on the center, bringing the blank half of the sheet down as a second leaf on top of the tracing and write on this second leaf the pattern dimensions, finish works, and all information which concerns the patternmaker only. If a witness mark *A* is placed near one corner of the tracing and if traced on the second leaf it will serve to locate the two sheets afterward.

In printing, a wire paper fastener holds the two sheets together, while printing the pattern copy, and the second leaf is opened out flat or turned back behind the print paper while printing a copy for the machinist.

On forging drawings where separate prints are furnished for blacksmith and machinist, the order may be reversed, the forging dimensions being put on the tracing and machine dimensions on the second leaf as indicated in Fig. 3.

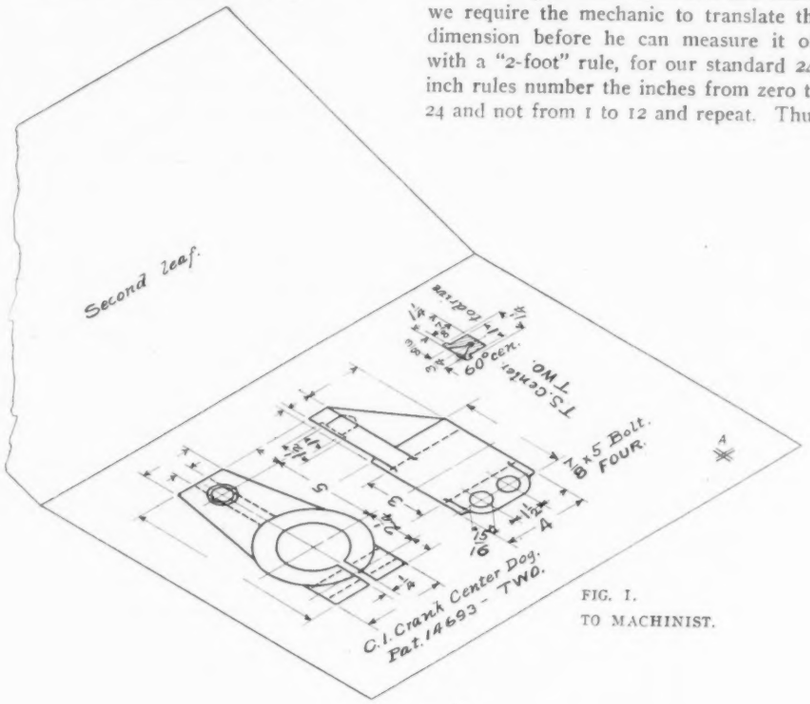


FIG. 1.
TO MACHINIST.

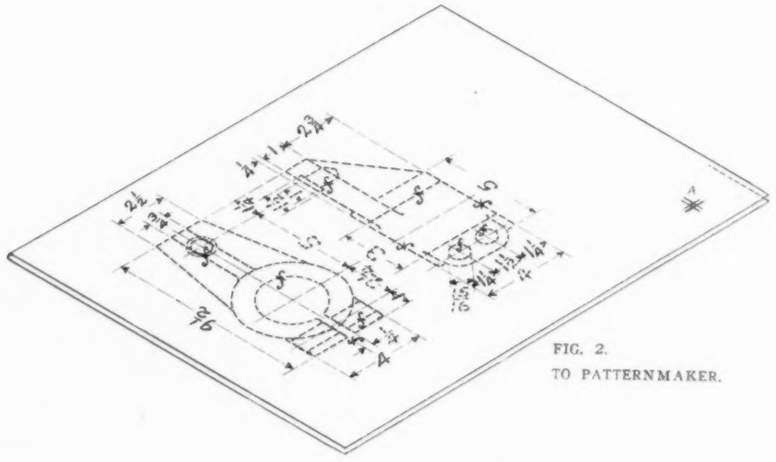


FIG. 2.
TO PATTERNMAKER.

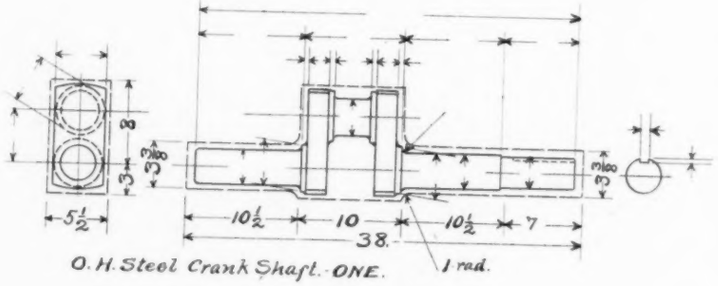


FIG. 3. FORGE PRINT.
INDICATING DIMENSIONS ON DRAWINGS.

In regard to the question of when to use feet and inches or inches only I wish to call attention to the rapidly increasing use of the 36-inch rule among mechanics, and in view of this I would suggest that we write such dimensions as 40 inches thus: 1 y 4, meaning of course 1 yard 4 inches.

In writing dimensions in feet and inches we require the mechanic to translate the dimension before he can measure it off with a "2-foot" rule, for our standard 24-inch rules number the inches from zero to 24 and not from 1 to 12 and repeat. Thus we might save the mechanic's time by writing 40 inches as 2 ft. 16, if we were sure he would measure it off with the old-time 2-foot rule.

JNO. D. RIGGS.

The Cutting Capacity of Power Presses.

The article on the above subject by E. W. Zeh at page 496, interested me very much, because it deals with a theme about which there is very little literature in existence. There are several points in Mr. Zeh's articles which are, in my opinion, incorrect, and to these I would like to call attention.

The illustration shows a diagram of a shearing operation when two parallel cutting edges are used in which.

P = maximum resistance against shearing of the material,

t = the maximum thickness of the material,

l = the width of the material,

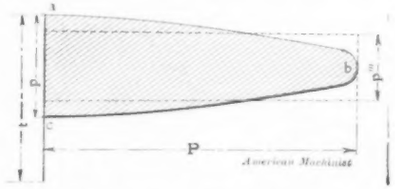
s = ultimate resistance against shearing.

Then

$$P = t\,l\,s \qquad (1)$$

p = depth of resistance and indicates how far the upper cutting edge has to descend before the material is severed.

In words, the diagram says that, the upper cutting edge at the downward movement finds a resistance which grows from naught to a maximum, and then falls again until the material is severed. It will readily be understood that a diagram of a shearing operation, if we assume parallel cutting edges, will always have a shape similar to that shown in the diagram.



ACTION OF SHEAR BLADES.

The area of the figure $a\,b\,c\,a$ represents the power which is required to shear a bar of the thickness t. Now we transform this figure into a rectangle of the same area. The length P of the rectangle is the same as the length P of the figure $a\,b\,c\,a$ and the height we call p^m = the mean depth of resistance; it is always a fraction of p.

Then the power necessary to shear a flat bar is A = area of diagram $a\,b\,c\,a = P\,p^m$

In formula (1) we found $P = t\,l\,s$.

Then is

$$A = P\,p^m = t\,l\,s\,p^m \qquad (2)$$

and

$$l = \frac{A}{t\,s\,p^m} \qquad (3)$$

The formulas Mr. Zeh developed say that

$$A = t\,l\,s\,p \text{ and } l = \frac{A}{t\,s\,p}$$

That these two formulas are incorrect will readily be seen if we look at the illustration. Expressed in words Mr. Zeh's formulas say, that the upper knife or blade finds the same maximum resistance during the full depth of resistance, and this certainly is incorrect, as practice teaches us that the upper knife or blade finds a resistance at the downward movement which goes from naught up to a maximum, and then falls again till the material is severed.

Further, Mr. Zeh says: "It is evident that there must be a law which governs this, and it may be said that the cutting length of a power press increases inversely with the square of the thickness of material." This certainly is incorrect when the cutting edges are parallel. We found in (2) that $A = t\,l\,s\,p^m$.

If we take now another bar of the length l_1, of the thickness t_1, of the depth of resistance $p^m{}_1$, which requires the same power, $A = t\,l\,s\,p^m$, to be sheared off, then we have

$$l = \frac{A}{t\,s\,p^m} \quad \text{and} \quad l_1 = \frac{A}{t_1\,s\,p^m{}_1} \qquad (4)$$

$$\frac{l}{l_1} = \frac{t_1\,p^m{}_1}{t\,p^m} \qquad (5)$$

This formula says, the cutting length of a power ress increases inversely with the product of the thickness of the material, and the mean depth of resistance.

As to the formula

$$P = \frac{t^2}{2} \cot \alpha$$

which Mr. Zeh cites as giving the resistance against shearing, when the upper cutting edge forms an angle with the lower one, I think it is needless to argue about it, as practice has demonstrated that it is incorrect.

I think the way which Mr. Jackson describes at page 381, Vol. 27, and the formulas given by Fischer in *Die Werkzeugmaschinen* have much more claim of correctness.

The shape of the diagram $a\,b\,c\,a$ and the values of P, p, p^m vary greatly for different kinds of materials. The elasticity, ductility, strength and thickness of the material and the speed of the upper cutting edge also play an important part in the values of these quantities.

It is very difficult, almost impossible indeed, to insert the factors A, P, p, p^m, t, l, s in formulas suitable for practical use. Perhaps a great number of tests with different kinds of material would allow some conclusions to be drawn in this matter, but such tests would only be of value if they were conducted with the greatest possible care, and on a scientific basis.

PAUL LANGE.

Saving the Hands From Dirt.

Common every-day vaseline is my protection against dirt and grease. A little rubbed into the hands each morning and noon is a hundredfold better than any dirt remover made, and a ten-cent bottle will last two months. The vaseline works into the pores of the skin, forming a coating which is impregnable to any dirt.

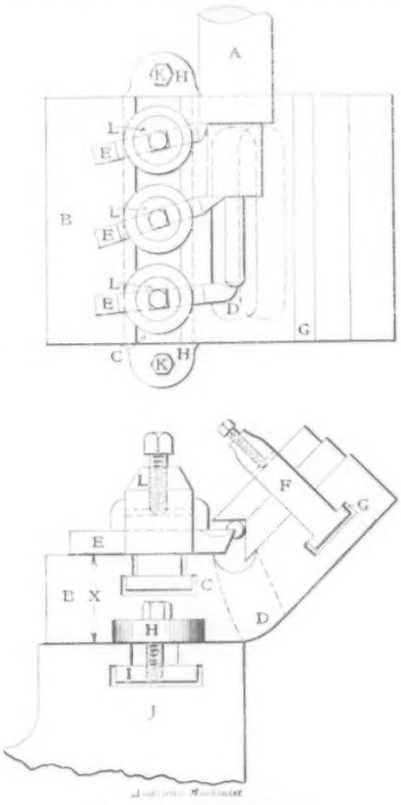
This is washed off at night, using soft water and a good "ivory-soap" lather. After a thick lather is obtained, dip the hands in corn-meal and proceed using soap alone, rubbing the meal into the crevices of the hands and fingers.

For the callous places on the forefinger, a cake of scouring soap, rubbed on lightly, is necessary. This may seem to be rather rough treatment, but not so, the light rubbing merely dissolves the dirt instead of "hogging" off the skin.

I have followed this practice for the last eighteen months, with results that are entirely satisfactory. FISK.

A Device That Was Not a Failure.

J. M. Menegus' article at page 506, on "A Device that Was a Failure," reminds me of a multiple tool-post—somewhat similar to his—that was a success. The device I considered at the time a happy combination of gray matter and gray-iron, the former supplied by me, the latter by the foundryman. Later on I discovered that the whole business was as old as the hills, the only possible claim for novelty (and even that doubtful) being that it was used in place of the ordinary tool-post instead of in a turret. The illustration shows it clearly. B is a gray-iron casting, the thickness of which is such that the top a tool E made of $\frac{3}{16}$-inch steel is in line with the center of the lathe spindle. A T-slot C runs the whole length of B. At the back the casting B runs upward at an angle of 45 degrees. Another T-slot G runs the whole length of the back.



THE MULTIPLE TOOL-POST.

The front T-slot C is provided with as many tool-posts L as the job A has different diameters to be turned. The back T-slot G is provided with the same num-

ber of back rests *F*. These back rests are —to avoid confusion—not shown in the plan. They are placed a little in advance of each tool. An oblong hole *D*—in *B* immediately under the tools—permits the turnings to fall out of the way.

B is secured in the regular tool-post *T*-slot in the cross-slide *J* by the two cap-screws *K* passing through the lugs *H* into the threaded holes in the flat steel piece *I*.

This rest was designed to turn 20,000 pieces like *A*, made of 15-16-inch cold-rolled shafting, reduced to 5/8 and 3/8 inch, the end of the 3/8-inch portion being rounded. The length of the piece was 7 inches, and of each reduced diameter was about 7/8 inch. The tool-posts and back-rest posts were rectangular in section, which afforded greater strength in less space than a round post would have done. The work done was satisfactory, both as regards quantity and quality. DIXIE.

Peculiar Effect of Sea Water on Gray Iron.

The above, commented upon by Dixie at page 62 and discussed by two other correspondents, is a subject familiar to all who have had to do with ships.

The following, culled from some lectures on boiler deterioration, by J. Hawthorne, M. I. Mar. E., may throw some light and prove of interest.

If a single metal be exposed to the action of an alkaline fluid, such as sea water, the results are as follows:

First—A chemical action due to the air held in suspension in the water, resulting in rust, FeO_2, the oxygen combining more readily with the iron than when the metal is dry.

Second—A galvanic action due to the presence of two substances, simple Fe and FeO_2, the latter being opposed in potential to the metal itself, which disintegrates and forms probably chlorid of iron and oxid mixed; this further action is due to the chemical action produced by the electric current formed by the couple. This repeated throughout a long period wastes the metal, and would in time destroy it altogether. It is generally known, I believe, that the oxid of a metal is always opposed to the metal itself electrically, one being + and the other —.

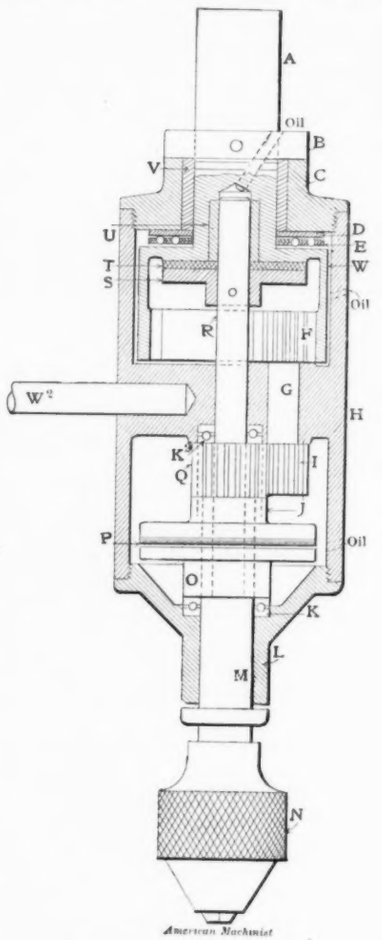
Gray iron, from its loose structure—the carbon being largely uncombined—would be set free to form another element in the deposit and thus resemble graphite; a more homogeneous material of a denser character, such as boiler plate, would show less injury. Zinc plates are universally used to negative the galvanic corrosion in marine boilers, the zinc being destroyed in place of the plate because more subject to galvanic action and being the opposite of the iron in polarity. The oxid is — to the plate, while the zinc is + and the positive or anode is destroyed.

In ships fitted with bronze propellers it is found necessary to secure zinc strips around the propeller aperture, to negative the destructive action on the plates of the stern of the vessel due to galvanic corrosion. A. L. HAAS.

London, Eng.

The Sensitive Tapping Head.

The sectional drawing shows a neat and efficient tapping tool, designed for use in a sensitive drill press, or as an independent machine, which can be supported in a suitable bench standard made to encircle the body *H* and fastened to bench or a floor stand, while the driving pulley can



A SENSITIVE TAPPING HEAD.

be attached at *A*. The construction consists of a body *H*, in which the mechanism is contained as shown. An end, or head, *C*, is fitted with a bronze or hardened tool-steel bushing *V*, in which runs an annular gear *W*, the shank of which extends through *C*, forming means of attaching (by an additional taper shank) to the drill spindle or for fastening a pulley to in case it is to be used as an independent machine. The gear *W* meshes with the pinion *F* fitted to shank *G*, which also contains another pinion *I* of smaller diameter, and in turn meshes with the pinion *O*, which is fastened to friction plate *J*, through which the tapping or main spindle *R* freely runs. The plate *J* has a fiber disk *P* fastened to it, against which plate *O*—which is fitted to the spindle *R*—can slide and still not turn except with the spindle. This is accomplished by squaring the spindle the length of the bearing of *O*, which has a square hole fitting freely on that portion of the spindle. Small ball bearings are interspersed, as shown at *K* and K^3, which serve to reduce the resisting friction of the revolving surfaces, thereby increasing the effective driving power of the friction plates *J*, *O* and *S*. In the shank of the gear *W* is a bronze bushing *U*, which serves as an end bearing for the spindle *R*. The friction plate S having a fiber facing *T*, is fastened to the spindle *R*, a pin passing through the hub of the plate *S* and the spindle *R*, as shown (a later construction has the spindle squared at that point and a square hole in the plate *S*, similar to plate *O* at the bottom). The inner surface of the gear *W* coming in contact with *T* and *S* imparts the direct or tapping motion to the spindle *R*. A lower end bearing *L*, of bronze, along with the upper bearing *C*, forms, as shown, the main support for the construction. A collar *B* is fastened on the shank of *W*, thereby holding the mechanism together in proper working relation. A hardened disk *D*, and thrust-ball bearing *E*, interposed as shown, have the same function as *K* and K^3. The tap is held in a small chuck, as shown fitted to the end of the spindle *R*.

In action, the working of the device is as follows: Upon depressing the spindle of the drill press carrying the tool, the tap meets resistance, and the pressure applied brings the inner surface of the gear *W* in contact with *T* or *S*, driving the tap into the work, which it will continue to do as long as the pressure is maintained. Upon releasing the pressure, the spindle *R* comes to a stop. Now, in reversing, it will be noted that the motion of the plate *J* is opposite to that of the spindle *R*. *J* is continuously running. If the tap or the work is held down on the table and the spindle of drill press lifted, the action is to lift the body *H*, which is held from rotating by a rod W^2, bringing the plate *O* in contact with *J*, thereby backing out the tap, the reverse speed being greater than the tapping speed, which is directly what the drill spindle is, while the reverse speed is proportioned to the velocity ratios of the gears.

One-thirty-second inch was the end motion allowed for changing the motion of the spindle *R*. It might be of some interest to note a few performances of the tool. It was run 1,2000 revolutions per minute, tapping speed, in brass castings. A 1/4x28 tap was used. The depth of hole was 7-32 inch. A run of one-half hour was made as a test; 430 holes, all perfect threads and all to correct depth, was the result. Another test employed a No. 3x48 tap, holes 3-16 inch deep, tapping speed, 1,800 revolutions per minute; holes were tapped to a bottom; 900

holes were tapped when the tap broke. The break was principally on account of the tap becoming tapered at the point, the clearance having worn off it. This test, I thought, fairly well established its claim to sensitiveness. H. J. WHITE.

Brooklyn, N. Y.

Milling a Cam-Shaped Recess—Angular Drilling—The Scrap Pile as Jig Timber.

Fig. 1 shows a gray-iron ratchet collar in one face of which it was required to cut a 3/8-inch wide annular groove through about 180 degrees and of 7-16-inch lead, the groove making a gradual increase in depth from nothing to 7-32 inch, and Fig. 2 shows the drill-press fixture, made for doing the work.

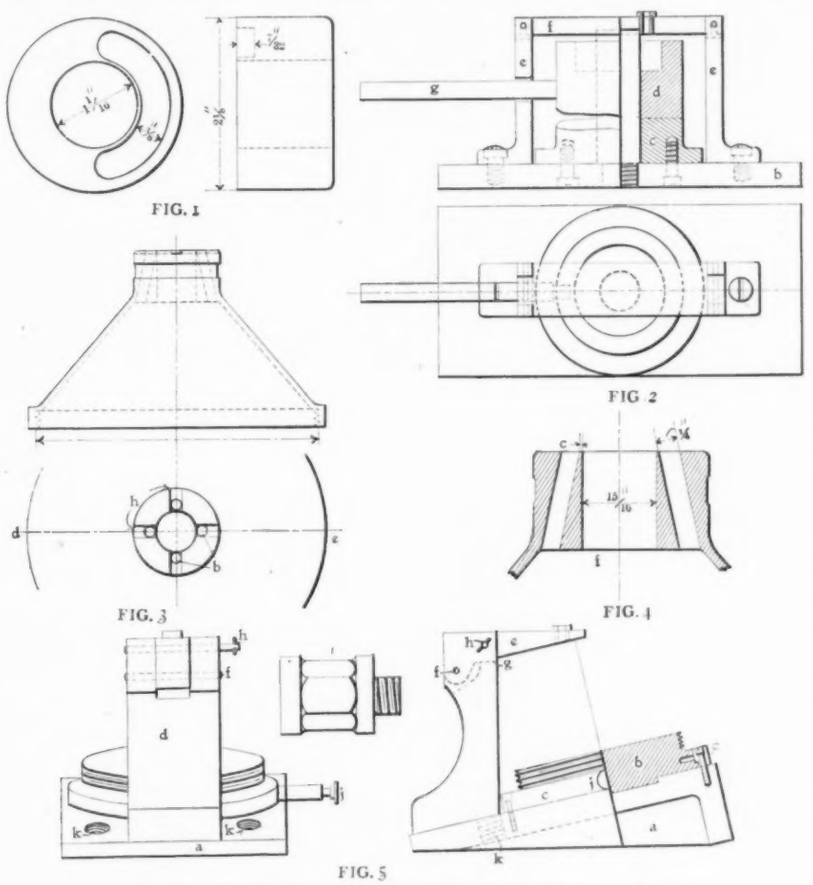


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

SOME UNUSUAL PIECES AND JIGS FOR MAKING THEM.

Into the base *b* was screwed a stud of the same diameter as the bore of the collar. Over this stud was slipped and secured to the base the cam-faced collar *c*, its upper face being a spiral cam, with one turn of 7-16-inch lead. Piece *d*, having a bottom face of the same shape as and matching the upper face of *c*, was a working fit on the stud. The upper end of *d* was counterbored to receive the work, which last was held in place by a hollow set-screw tightened by a small wrench. On opposite sides of the stud were placed two standards *e e*, into whose upper ends was tenoned a crossbar *f*. This bar was so fitted as to be readily removed, but held firmly when in position, and at the proper place was located the guide bushing for the cutter.

The cutter, of high-speed steel, was made with taper shank for the sensitive drill press. In use, the fixture was located on the drill table by the cutter in the guide bushing and clamped. Bar *f* was then removed, the work inserted and clamped and the bar replaced; the drill spindle was lowered to a stop and held while the work-carrying collar *d* was rotated through one-half a revolution by means of handle *g*.

Fig. 3 shows a bowl top from a well-known Canadian cream separator. It was required to drill four equidistant holes *b*, 1/4 inch diameter, at such an angle as to leave about .010 inch of metal between the large and small holes at *c*, Fig. 4, and on the inside to cause the hole to come out even with the place where the oblique surface joins the inside face *f*.

Fig. 5 shows the jig as made for drilling and also for a milling operation, to be described later. The proper angle being calculated, base *a* was planed up, as shown, and recessed for a projection on bottom of work-holding plate *b*, which was held down to a working fit by ring *c*. At *d* is a standard, having fittted to its top end of the drill-bushing arm *e*, which hinges on taper pin *f*, rests squarely on surface *g*, and is locked by pin *h*.

About the periphery of *b* are four equidistant indexing holes, into which the spring index pin *j* enters. The *modus operandi* will doubtless be clear without further explanation. It was also required to mill two slots, 9-32x1-16 inch, across the top face of the bowl top at *h*, Fig. 3, and for this operation the base *a*, Fig. 5, was tapped at *k* for two legs, which legs, shown in the detail, were of right length to make the top of the base-plate parallel to the platen when clamped thereto arm *e* being thrown back out of the way for milling. When used as a drill jig, the feet were screwed in from the top to prevent their being lost. The bowl tops having been drilled on this fixture, the holes in all tops were sure to come in line with milling cutter when milling the slot.

In most well ordered shops, when the toolroom gets a jig to build, it receives a suitable drawing, and castings, etc., are soon forthcoming. Is there a hole to be drilled?—a boss will be provided for it. Is a steel ring required?—the blacksmith has it made to drawing in short order. In other words, the toolmaker's work is all cut out for him, and he can do nothing but follow drawings and orders.

Where we built the above jigs, however, we were untrammeled by any such cut-and-dried methods. Having conceived some way whereby the required operations could be jigged, and having secured the approval and criticisms of the man higher up, we would proceed to build the jig. Our jig timber consisted of a large and beautifully assorted collection of scrap, which was the result of a disastrous fire that had wrecked the shop previous to our appearance. Without having any dimension about the jig exactly decided upon, the pile of "fire" tools would be carefully overhauled. There are several rings that might do for that clamping-down ring (*c*, Fig. 5), but the most promising is a thread gage of about 4½ inches inside diameter. The use of this depends, however, on the finding of the other parts of such a size as to match the ring. As nothing else needed can be found here, we procure our dissecting instruments (hammer and monkey-wrench) and approach the very much larger agglomeration of scrap, consisting of burnt machines and loose parts in the far end of the shop. Gee! here is the very thing, if it's big enough—yes, it will do—the hub from a Jones & Lamson turret lathe handwheel. It has four spoke holes in its rim, but we will saw off the bent and twisted arms, close up and pin the ends in, and it will be as good as new.

This leaves one important part to be discovered—the base—and we are about to give up finding anything suitable when we come to a pile of architectural remains—tie-rods, etc.—and find just what we need. It has evidently been used for a cap on top of a post or some such purpose,

but surely the man that made that casting must have had our jig in mind.

Having thus obtained the material, we proceed to build the jig, making diameters, bores, lengths, etc., to suit our own sweet will, having in mind only one consideration —the proper working of the whole when done. Surely a most interesting way to make a jig. RAYMOND GRANT.

Oil Fuel in the East.

Under the head of "The Use of Fuel Oil on the Pacific Coast," at pages 377 and 426, F. A. H. writes in a manner which is calculated to leave the impression that the east coast is far outstripped by the west coast in the use of fuel oil. Knowing full well the broad influence an article published in your magazine has, I herewith submit a few facts which I hope it will be your pleasure to publish in justice to the mechanical ability of our friends of the east coast, especially those of the Navy Yard at Norfolk, Va.

The blacksmith shop in the Norfolk Navy Yark is run strictly with hydrocarbon gas and fuel oil—not a pound of coal being used. For the past three years gas has been used as fuel in all the blacksmith shops, forges and furnaces. The gas is made by an Acme gas plant from 68 to 70 B. gasolene and the shop is most pleasing to the eye, being entirely free from smoke and dirt. This gas plant is considered the most successful of its kind in operation and it has run continuously without a hitch since it was started in August, 1902, excepting two days when it was stopped on account of the blowing out of the safety flange.

They have at present in operation fuel and crude oil furnaces and forges as follows: Angle-iron heating furnaces, 45 feet drying furnaces, core ovens, brass-smelting furnaces, drop forging furnaces, bolt and rivet furnaces, large forging furnaces up to eight tons, and have recently installed some Mircs blacksmith forges, which are considered much better than the gas forges, as they are cheaper in the consumption of fuel and are adapted to all classes of smith work, such as angle iron, eye bands, shackles, chain work and forging work.

Some very difficult jobs of welding have demonstrated that the welding heats made by this oil forge are better to work up than that of the gas forge, as the oil heat seems to penetrate the metal throughout as mentioned by F. A. H.

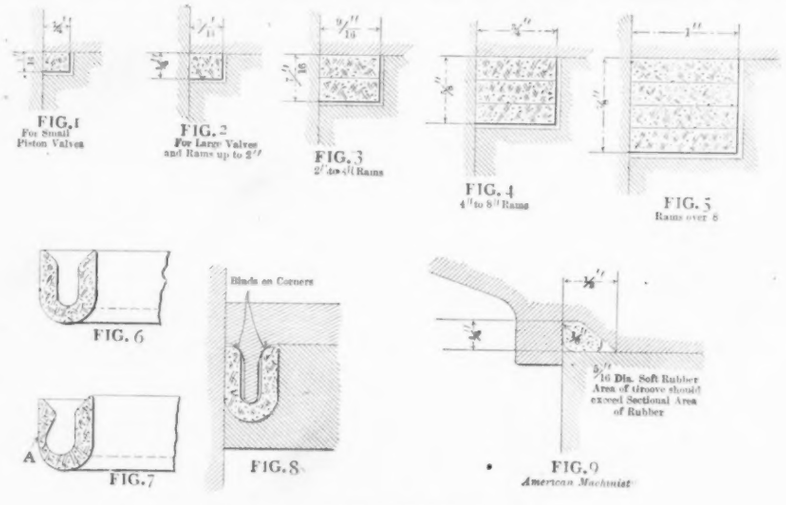
The blacksmith forge to use fuel oil has up to this time been in the experimental stage, but the Mircs oil forge seems to meet the demand. I mention this forge for the reason that I do not think there is another oil blacksmith's forge in use today, where the smith can move the loose bricks on top of the forge to suit the material to be heated. To see the forge in operation one would think it a gas forge, as combustion is absolutely complete.

A. M. WILKINSON.

Hydraulic Leathers.

Regarding hydraulic leathers, I was much interested in the article at page 459 on hat, cup and U leathers. I believe these same leathers, like chordal pitch in gears, to be a relic of barbarism, and call to mind an expression of opinion from an engineer of very high standing that they were "an intolerable nuisance." I also recall a conversation with the president of a large shipbuilding company, the burden of which was that he would not have a hydraulic machine in the plant if it could be avoided.

It is, however, possible to construct hydraulic machines of almost any type without the use of leather packings, at least of the variety usually employed. A leather packing which is much more desirable than the usual cup, hat or U shapes, and which possesses the further advantage of not requiring forms to make it, is illustrated in Figs. 1 to 5, inclusive. The proportions there given may be taken as representing good practice, but may be varied to suit conditions or to conform to the personal tastes of the engineer.



HYDRAULIC LEATHERS.

The outside of a cylinder packing is turned and the inside of a ram packing is bored an easy working fit. All other parts of the packing are left rough. The multiple leathers are firmly stitched together.

This type of packing has worked successfully on pressures ranging up to 6,000 pounds per square inch, and I do not know that there is any practical limit to its use.

In the article previously referred to, stress is laid upon the importance of chamfering the edges of the packing as per Fig. 6, and an instance is given of where the failure of a machine was due to the neglect of this alone. At the same time the well-known fact is illustrated that packings wear at *A*, Fig. 7, and that the tightness of the joint, as also the friction, is entirely independent of the length of the packing. Now, this being the case, what difference does the form of the edge make?

This is but one of the many little practices which are followed blindly from year to year, the fallacy of which would be quite apparent should we but pause to investigate. I have known packings to work quite as well with the edge square as with it chamfered, when *there is room enough*. If, as is usually the case with old machines, the molds were made of the proper depth for a chamfered leather to *just clear* the fillet, it would of course bind if not chamfered, and in that case not work properly, as shown in Fig. 8.

Again, it is very doubtful if any drilling designed to bring the pressure to act upon any particular portion of the leather is of any real practical value when we remember that a fluid transmits pressure equally in all directions.

The following is a condensed specification for leather packings which differs somewhat from the ordinary:

Make of hard, close-grained, oak-tanned sole leather.

Shave to uniform thickness shown on drawing.

First, soak in warm water until pliable.

Draw into molds with flesh side the working side of packing.

Clamp molds tightly together and leave until packing is thoroughly dried.

Trim packing to exact hight given on drawing.

Soak hydraulic leather ½ hour in paraffin at blood heat.

Drain and dry slowly in warm place.

Soak pneumatic leathers ½ hour in tallow at blood heat.

Drain and dry slowly in warm place.

Cut square leathers with sharp washer cutter, cutting from one side of hide only.

Soak ½ hour in paraffin at blood heat.

Drain and dry slowly in warm place.

Another set of specifications for hydrau-

lic leathers long used by a prominent firm is about as follows:

The material should be close-grained, oak-tanned sole leather, of firm and even texture, shaved to a uniform thickness of 5-32 inch.

After being dipped in warm water sufficiently to moisten and soften (not soak) it, it should be for an hour or more in tallow just warm enough to be liquid.

The mold should be made as warm as can easily be held in the hand, closed upon the leather very slowly until thoroughly tight, and allowed to stand twelve hours or more.

It is sometimes the case that a leather packing is used to make a joint at a cylinder cover or other such location, where there is no relative motion of the parts, excepting that due to the deformation resulting from the strain. I have found a solid cylindrical ring of rubber to be admirable for such locations. A form of groove well adapted to such a packing is shown in Fig. 9. The rubber can be bought in any lengths required and cemented together to suit the particular place used. For pipe flanges and other locations where the number used is large, solid molded rings of such size as to exactly suit the conditions can be kept on stock and cost little more per pound than the straight rubber.

A READER.

German Braces and Bits.

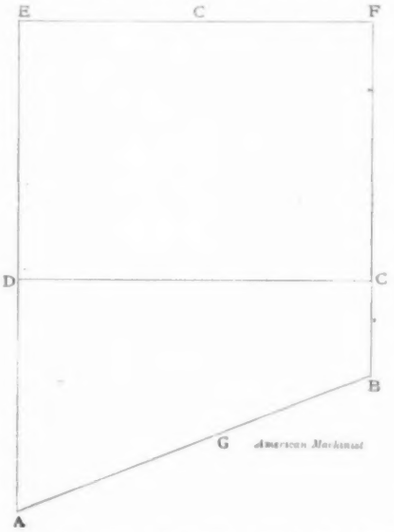
In many things American manufacturers and exporters seek to please their foreign customers; but often they try to persuade the dealers that they can sell things at which the retail dealer, and the retail customer who is behind the dealer, refuse to look. St. Paul found out long ago that it was no use kicking against the pricks. Why should not the American manufacturer and exporter learn the same lesson? I will take as an example the ordinary flat wood bit. The German carpenter loves it and wants it made his own way to fit the brace he has inherited from his grandfather, or which the present brace manufacturer makes exactly as his grandfather made it before him. The bit must have a flat, not a "four-square," shank, and of course the brace is made to take this in, with a thumb set-screw to hold it in place. I have just bought a German brace and a screwdriver bit therefor, paying for the first the enormous sum of 75 pfennigs (less than 17 cents), and for the second 30. They are not things of beauty—especially the brace—but they work; and I had my choice of buying them or losing an hour waiting for one made in God's country. And come to think of it, in this particular the German is about three-fourths right; for such flat bits with flat shanks require less stock than those with four square ones, and take less time to make. And what is of equal importance, the bit is double-ended, so that I have at one end a bit one centimeter wide and at the other one double that width. Further, this brace is the nicest thing out to drive screw-eyes.

Apropos of braces, let me suggest that when American toolmakers send out to Germany catalogues which they suppose to be in the German language, they be sure that they have got hold of the right words, not relying too much on the technical dictionaries, which sometimes are very strongly suggestive of that famous Portuguese book, "English as she is Spoke." One enterprising toolmaker, or exporter, whose "zeal was not according to knowledge," translated "brace" with *"steg,"* which means a strut brace, instead of with *"bohr-draube,"* which is the usual technical term by which it is known in the German hardware trade.

R. G.

Locating the Elevating Screw for the Miller Knee.

In deciding the position of the elevating screw under the knee slide, appearance is more often considered than is the center



LOCATING THE ELEVATING SCREW FOR THE MILLER KNEE.

of gravity. This should, undoubtedly, be the deciding factor.

In view of this, a method used for finding the center of gravity of the knee and slides may be interesting. The various parts had been made before, and therefore their relative weights could be got direct from the foundry returns. The distribution of metal in the knee was first considered and the quadrilateral *A B C D* was drawn, which represented the weight to a scale of one square inch equals a hundredweight. The slides and table were considered to be in the mid-position and the weight was represented by the rectangle *C D E F*. The figure was then cut out of stiff paper and its center of gravity found by the well-known method of swinging from two or three points and dropping vertical lines.

The friction of the ways was not considered, for, when the screw holds the weight, the friction due to the tightness of the guides should be small.

Manchester, Eng. H. T. MILLAR.

Water-Wagon Design.

J. E. Ternan, in his article on "Water-Wagon Design," on page 567, wishes to know if there is any real good reason why a self-propelled water-wagon should not have the sprinkling apparatus in front. When the ordinary macadamized or asphalted roadway is sprinkled by the water-wagon, the mixture of the water with the dirt, always present on such a surface, forms an exceedingly greasy, slippery muck, of a lard-like consistency. The driving of a self-propelled vehicle of any type on such a surface is always attended with more or less danger, since the wheels slip and skid, and in case the brakes are applied suddenly, control of the machine may be entirely lost.

This difficulty of control increases almost directly as car-weight increases.

A self-propelled water-wagon, therefore, with sprinkler-nozzles in front and with a ton or two of water sloshing around in its inside, would be extremely difficult to control, and therefore inefficient.

FRANK R. FARNHAM.

Gang Fixtures for Multiple Spindle Drills.

In speaking recently of a certain multiple-spindle drill a man said the machine was good for straight drilling only. I know, however, that with a multiple chucking attachment for holding various kinds of brass work, for instance, plumber and engineering specialties, this type of machine will prove of great additional value.

Take for example the making of faucets: if you have a 20-spindle machine you can ream out 10 faucets in the same time required for one handled in the ordinary way. By adding a reverse belt for tapipng, the machine becomes of more value than even the makers realize themselves. This idea comes from Switzerland, and is used in a shop near the city of St. Gall. Selecting, say, the making of packing nuts and using a machine with 18 spindles, three tools being required to finish one nut, the 18 will finish six nuts simultaneously. The spindles are set in three rows, six spindles in each row. In the first row are the roughing tools, in the second the finishing tools, in the third row the taps. Care must be taken in designing the multiple chuck or fixture, as no two castings are exactly the same size.

ADOLPH J. SPITZ.

The R. D. Nuttall Company, Pittsburg, Pa., has lately installed one of the largest gear-cutting machines, for cutting gears by the milling process, that is manufactured. This machine will cut spur gears up to 20 ft. in diameter, 3 ft. face, and up to a 7" P tooth.

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Contents.

	PAGE
Some Observations on Iron Burners	623
Molding Machine Equipment	624
Electric Traction for the Erie	629
Simple Steam Turbine Engines—I	629
Some Locomotive Shop Tools	633
The Kawasaki Dockyards	634
The New York Central-New Haven Electrification	634
A Novel Method of Original Indexing	635
Making a Clutch Coupling on the Molding Machine	636
Echoes from the Oil Country—The Waste Basket as a Source of Mechanical Information	637
A Large Pattern Storage Building	639
Letters to the Editor	640-649
The Honesty of the Japanese	650
Export of Coal From England	650
A Suit to make Employment Permanent	650
New Tools and Machine Shop Appliances	651
Rotary Thread Rolling Machine	653
The Layout and Construction of Cams	654
Personal	655
Obituary	655

The Honesty of the Japanese.

So much has been said against the Japanese reputation for business honesty, that it is a relief to finally hear something upon the other side, and that which we now hear seems to be very significant. It comes from the manager of the publication department of *The Times*, of London, which has been publishing and selling in Japan sets of the "Encyclopedia Britannica." These it seems have been sold in large numbers in Japan, upon the plan usually followed here; that is, on instalments to be paid at stated times. Ninety-five per cent. of these encyclopedias sold in Japan were sold to Japanese, and not to foreign residents. The monthly payments were for about the same amount in Japan and in Great Britain. In Great Britain less than half the payments arrived on the day of promise; in Japan less than one per cent. of the payments were even one day late, and more than one-half of the payments were made the day before they were due, because the Japanese did not like to run the risk of any accidental delay that might make them even one day late. The cost of collecting the instalment payments in Japan was less than half as much as in England, simply because the Japanese were so punctilious that clerical labor and postage were not expended in collecting. Furthermore, the Japanese bought five times as many encyclopedias as were sold in France and Germany combined; fifty times as many as in Russia; more than in any other country, except India, Australia and the United States.

In the cases of young Japanese men who had subscribed for the encyclopedia and who abandoned their employment and went to the war, their families nearly always met the payments when due, even when it was done with the utmost difficulty, and when they were living under distressful circumstances.

These statements, needless to say, speak volumes for the character of the Japanese, and ought effectually to dispose of the slander that there is no business honor among them and that they cannot be depended upon to live up to a contract. The fact is, of course, that the Japanese people are the same in this respect as those of other nations, and that in every country people can be found who will not keep a contract unless compelled to do so, while on the other hand, others are found who guard their commercial honor with the utmost care. We ought all to learn that no race of men has a monopoly of honesty and honor, nor of dishonesty and dishonor.

Export of Coal From England.

Our consul at Nottingham, England, discourses in a written communication of the frequent complaints made that the British coal export trade is languishing, especially so far as that trade is concerned with the exportation of coal to France. It is said that the probable explanation of this decline of the trade, or business of sending England's coal to France, is found in the increased activity of German coal producers, who have thereby increased the German exports of coal to France, and there is a bounty paid to the German exporters of coal in order to promote its exportation. On the other hand, instead of British coal exporters being paid a bounty, they are required to pay a government tax on coal exported, representing from 12 to 15 per cent. on the price of the coal at the pit.

This lament very well illustrates the directly antagonistic interests of a good many industries; for it is morally certain that the exportation of coal from England is economically a very bad thing for England. The supply of coal in England is limited—the end of the supply is within sight. The payment of a bounty for the exportation of this coal would result in one of two things, or both—an increase of the price of coal consumed in British industries, or an increased amount which could be charged by the owners of British coal mines as royalty for the privilege of digging coal. It is not likely that the actual diggers of coal, or those who operate mines in Great Britain, would in the end get any more for their labor, or for the employment of their capital in the coal business. The only effect of it in the end would be to further hamper British industries, and to increase the monopolistic value of British coal mines.

If our modern form of civilization depends largely upon coal, as undoubtedly it does, it would seem as though England is wise in repressing exportations of coal, and that Germany is pursuing a course which is unwise, and which will in the end prove to be disastrous. No country can grow rich, or improve its economic condition, by exporting that which is necessary to its national life, and scarcely anything can be imported into England in return for the exported coal which will be more useful or more vitally necessary than the coal.

A Suit to Make Employment Permanent.

A case has been brought in the United States Court at Cincinnati, the decision of which is likely to be of considerable interest to employees and employers in any line of work. It seems that a man named Stetson was taken from a bench where he worked for the Meek Company, of Coshocton, O., and put on as a salesman. He developed exceptional ability in this line, and after working for a time in that capacity, left the company named and engaged with another. Thereupon the Meek Company brought suit to prevent his using in the service of another company the knowledge or "education" he had received.

We do not understand that in this case there was any contract that Stetson should

work for a given length of time, and if it is decided that he has no right to render service to another company, based upon experience obtained in the service of the Meek Company, then so far as we can see it will mean that a mechanic who may have been employed by a machinery building firm and has gained special experience in a certain line of machinery while working for them, will have no right to engage with another machinery manufacturing concern making a similar line of machines, and to use in the service of the second company the skill and experience derived while working for the first company.

Stated in this way, we see at once that the effect of such a decision, if it should be finally accounted good law, would be quite revolutionary; it would entirely change the present methods of developing and of securing the services of skilled labor, and it would almost prevent the establishment of new industries in lines that had been already established, because no workmen could be employed in such new establishments; at least none whose services would be of any value. There is no telling what a court's decision may be, but we venture to say that it will be a long time before any court decision, or law, will prevent an employer from engaging men possessed of the necessary skill to carry on his business.

One of the distinguishing marks of a successful employer is the ability to retain the services of men who are of value to him; he must be able to judge accurately of the situation at any given time and to feel pretty sure that he is paying a valuable man as much as any one else would be likely to pay him.

A thing has happened in connection with our foreign machinery trade, which a few years ago most Americans would have considered to be forever impossible. Twelve thousand workers in New Zealand have petitioned their Parliament to prevent our American Harvester Trust from exploiting the markets of New Zealand, and they base their opposition to this trade upon the alleged fact that the conditions of labor are so much better in New Zealand than in America, that New Zealand manufacturers cannot hope to compete with American cheap labor. They therefore demand a duty of 40 per cent. on all goods sold by the Trust in New Zealand; the alleged object being to "maintain the high standard of living which New Zealand workmen enjoy." Needless to say, the proprietors of the New Zealand agricultural machinery establishments agree with their workmen regarding these points, and the only opposition comes from the farmers, who naturally wish to purchase harvesting machinery at the lowest possible figure.

Hot air is all right, but should be compressed before use.

New Tools and Machine Shop Appliances.

48x48 INCH BY 18-FOOT PLANER.

The two half-tone illustrations show a new 48x48-inch planer of a very heavy type, its weight being 75,000 pounds; it is operated by a Thompson-Ryan variable-speed motor of two-to-one variation. As will be seen by the illustrations, an improved form of housing is used in this machine. The side walls of the bed are tied by heavy cross-girts, and it is reinforced by double walls at the gear space. The bed is twice the length of the table, thus avoiding any overhang. The table is so designed that no chips nor dirt can drop between the tracks. The standard table has T-slots and reamed holes, but any design can be furnished without extra charge. The table is of unusually deep section and of complete box form. The chips are withdrawn through large holes provided at the sides. The rack is 11 inches wide and of 2 pitch, and all the gearing is of steel. The uprights are of box form and are finished to receive side heads, whether the latter are ordered or not, so that the heads can be attached at any subsequent time. The rack and all gears are of steel. All pinions are steel forgings and are of 15 teeth or over, thus insuring smoothness of motion. The driving shaft bearing next to the driving pinion is ring oiling.

The crossrail is of box form, and is of such length that the front head can traverse the entire width of the planer. In addition to the gibs on the outside of the upright, there are also clamps on the inside; thus the strain of the cut is not transmitted across the face of the upright, which is the weakest part of the crossrail.

The tool slides can be swiveled to any feed at any angle. The tool apron is made extra wide, with T-slots, allowing the tools when set on the inside edge to come close together. The sidehead will travel entirely below the table, and it has an exceptionally long bearing on the upright. The tool slide can be swiveled to any angle. The outside tool apron is made flush with the top of the shoe, allowing the tool to be set so as to traverse the entire capacity of the planer. The crank-wrench for adjusting and traversing the head vertically is on the head itself.

The feed adjustment for the heads on the crossrail is made on the end of the crossrail, and for the sidehead on the sidehead itself. By means of notched plates any desired feed within the range specified can be instantly obtained while the planer is in motion on its shortest stroke. No feed boxes are used, the reciprocating motion for the feed operation being obtained from the running gearing by a device which gives the maximum amount of feed required, with only about 3 inches of table movement. And as the amount of feed is governed in the circular disk shown at the end of the crossrail, and as the function of the feed is performed at the commencement of the table movement, it is not necessary to extend the table movement beyond the length of the work more than ½ inch for minimum feed, varying from that to 3 inches to obtain the maximum travel. All the heads therefore have independent feeds, both as to amount and direction. All the bearings wherever possible are self-oiling.

A test of the power of this machine was

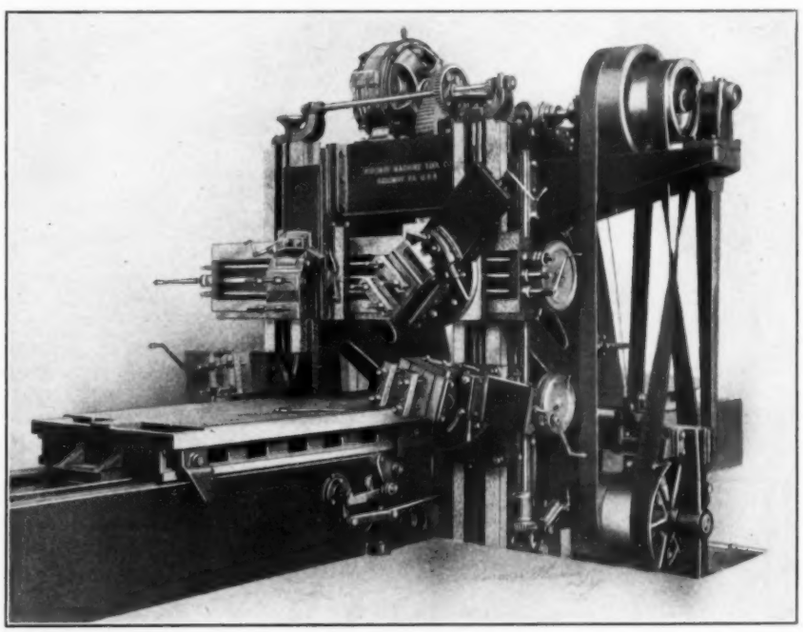

FIG. 1. 48x48-INCH BY 18-FOOT PLANER.

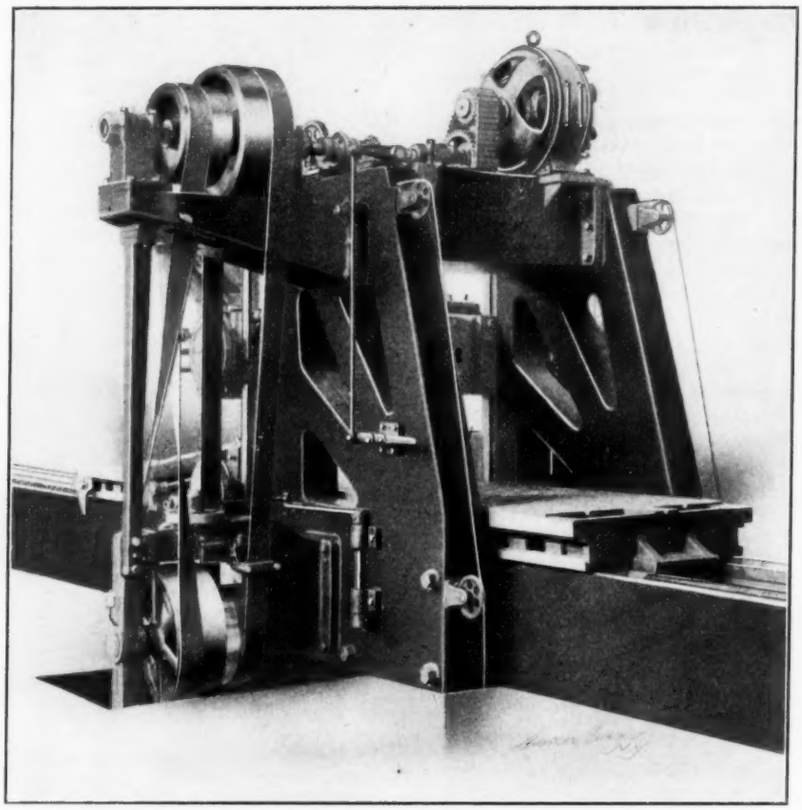

FIG. 2. 48x48-INCH BY 18-FOOT PLANER.

taken in the shop, and four cuts of 1 inch deep by ⅛ feed were carried simultaneously, the power required to carry these cuts being 35 horse-power.

This planer is built by the Ridgway Machine Tool Company, of Ridgway, Pa.

HEAVY DRIVING WHEEL LATHE.

Among the interesting points of a new heavy 90-inch driving-wheel lathe, which is driven by a 30 horse-power variable speed electric motor, is the mechanism by which the tailstock is traversed back and forth. The tailstock has bolted to it a bracket from which is hung a small electric motor which is geared directly to the traversing screw. The intermediate gear of this train has a safety device by which it is possible to run the motor at its fullest speed, bringing up the center at a rapid rate solidly into place in the axle, without the necessity of slowing down or stopping the motor. The power of this device can be adjusted so that just sufficient force is applied, thus avoiding the necessity of adjusting the centers by means of the hand wheels.

Another interesting feature is the construction of the drivers. The face-plates have large oblong recesses to admit the crank-pins, so that the wheel may be brought close up to the face-plate, thus diminishing the overhang of the dead centers. The drivers are so formed as to grip the spokes firmly, and are provided with caps which are slipped on after the wheels are in place, covering the spokes on a fourth side, and preventing buckling or distortion of the wheels and giving a rigid drive. Each face-plate is provided with three of these driving dogs.

The feed is taken directly from the face-plate, and the feed plate being close to the operator it is possible to adjust the amount of feed without leaving the tool-posts.

Some tests made of this machine at the works of the builders on October 19 gave the following results:

First a pair of driving wheels was turned with high-speed tool steel, the amount of metal removed being 250 pounds, the power consumed varying from 6 to 26 horse-power, and the feed and cut at the commencement being 7-32 inch and

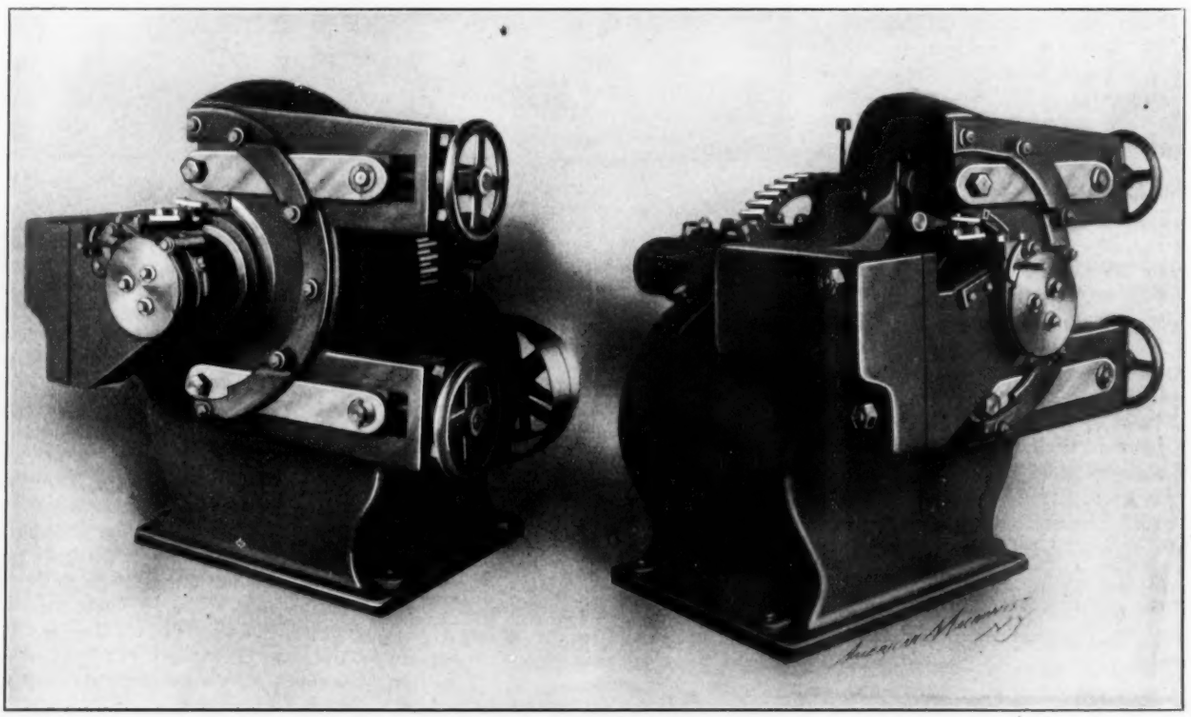

FIG. 1. ROTARY THREAD-ROLLING MACHINE.

½ inch respectively, with a cutting speed of 7½ feet per minute, the feed being later increased to ¼ inch and the speed to 14 feet. The net cutting time was 1 hour and 28 minutes, including time of replacing tools.

Another pair of wheels, 57 inches in diameter and very badly worn had 180 pounds of metal removed, the power consumption being the same as in the other trial; the feed was ⅛ inch at the commencement and the depth of cut ½ inch, the cutting speed being 16 feet per minute. The feed was later increased to ¼ inch. The net cutting time, including changing tools, was 59 minutes.

This lathe is built by the Ridgway Machine Tool Company, of Ridgway, Pa.

A locomotive testing laboratory is to be built in Germany at the Grunewald Works, on similar lines to that at the St. Louis Exposition. It is to be in charge of the well-known locomotive designer, Professor Von Borries.

Rotary Thread Rolling Machine.

In this machine the threading dies, instead of being of the reciprocating type, are composed of one rotary die which runs continuously in one direction and one segmental die which remains stationary after it is adjusted to the job. The bolt or piece that is to have the thread rolled on it is passed between the two threading members and carried around with the rotating die, which is mounted on the main shaft or spindle. It will be seen that the machine differs radically in construction from roll threaders of the reciprocating type.

The illustrations will make clear the general construction of the machine. The adjustment of the distance between the two dies, which of course controls the diameter, is effected by means of the hand-wheels shown in Figs. 1 and 2. The segmental die is carried in a heavy block that is eccentric to the shaft, and by loosening one of the hand-wheels and tightening the other, the adjustable die is advanced or withdrawn from the rotary one. The feeding mechanism is also clearly shown in the several views, and will be best understood from Fig. 3, where *A* is the rotary die, *B* the adjustable shoe carrying the segmental die, and *C* the driving spindle.

The bolt *D* is placed in the jaws *E*, then the operator starts the bolt into the machine by moving a handle (extending out from the feeding carriage) attached to pawl *F*. This handle is shown in the half-tone and drops the pawl into engagement with notched disk *G*, which carries the oscillating carriage *H* forward and passes the work between the dies, the rolling beginning at once, and the jaws then opening automatically and allowing the carriage to drop back to the feeding position again.

There are four opportunities for feeding in every rotation of the die, as there are four notches in the disk. The bolt or rod is fed into the machine horizontally so that bridge rods, car truss rods or other work of almost any length may have threads rolled on the end, and the heavy,

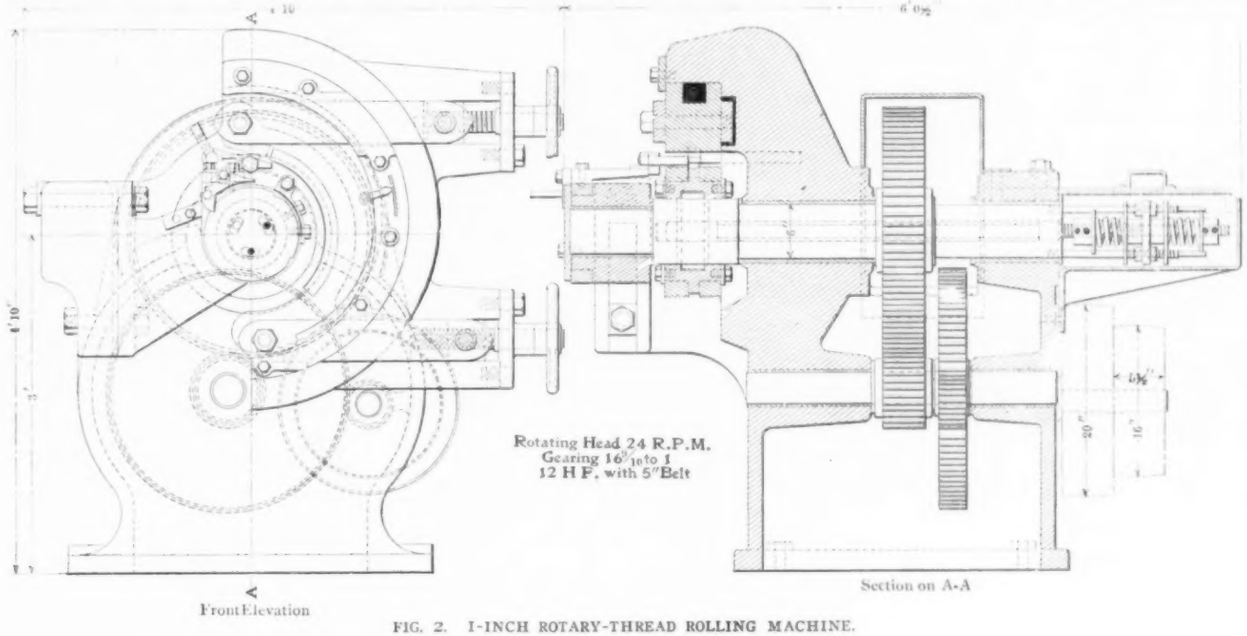

FIG. 2. 1-INCH ROTARY-THREAD ROLLING MACHINE.

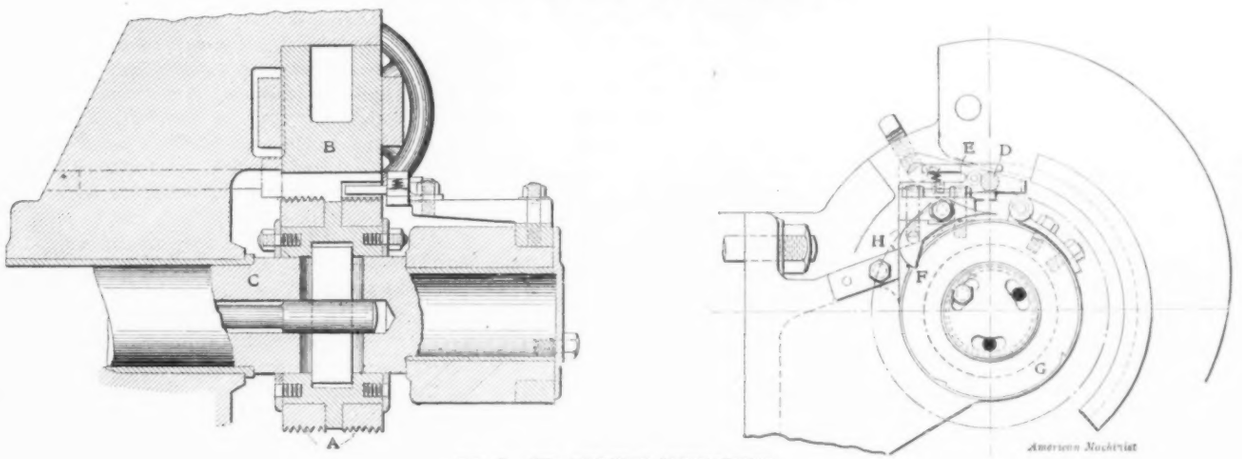

FIG. 3. DIE AND FEED MECHANISM.

compact construction enables the machines to be built to roll up to large sizes. It will be seen from Fig. 2 that at the rear end of the main spindle there are two spiral springs and means for putting them in tension; this is an important feature, as it keeps the dies in pitch.

As the bolt enters and the rolling begins at different points on the dies, the breaking down, or the beginning of the thread, is not confined to one particular place, so that the wear is general and uniform over the whole die surface. The dies admit of fine adjustment for the required size of work, or to compensate for wear.

The comparative merits of cut and rolled threads are well known generally by engineers; still it may be of interest to give the result of a recent test of the two forms of thread, the material in both cases being machine steel:

1¾x24⅝-inch cut thread — tensile strength, 88,900 pounds.

1½x24⅝-inch rolled thread — tensile strength, 95,850 pounds.

The rolled thread is of course not adapted for every purpose, still the above test shows that where it may be used there is a great gain in strength and a consequent saving of weight and cost. In this connection it may be of interest to note that one of the largest contracts for bolts ever let in this country was the recent contract on the Pennsylvania Railroad tunnel from Jersey City to New York; the bolts required aggregated about 8,500 tons, and they were all specified to be with rolled threads.

The machine shown is made in two sizes —1- and 2-inch—by the Acme Machinery Company, of Cleveland, Ohio.

The Layout and Construction of Cams.

BY C. F. SMITH.

The accompanying illustrations show forms of cams which escaped my memory when preparing the articles which were published last spring.

Fig. 1 shows what may be described as an intermittently operating worm gear. The cam is of the raised pathway type, and has two complete turns of the pathway on its periphery. The driven member may be a disk having a series of rollers projecting radially from its circumference, or, better, from its face. The illustration will make it plain that these rollers will engage the cam groove in succession, the disk being turned by a series of steps with long dwells between.

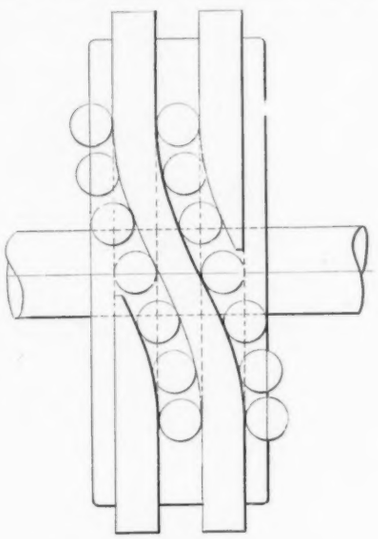

FIG. 1. INTERMITTENTLY OPERATING WORM.

Fig. 2 shows a cam in which two revolutions are required to effect the complete going and return movement, and in which these movements take place at the same point in the revolution of the cam shaft, although this latter feature may be easily changed. In this construction, the usual roller is replaced by a boat-shaped piece *a*, which is swiveled on a supporting pin and is of sufficient length to insure its following the cam groove in the desired manner. It is obvious that at each revolution of the cam the boat will reverse its position and take the opposite groove to the one followed during the previous revolution.

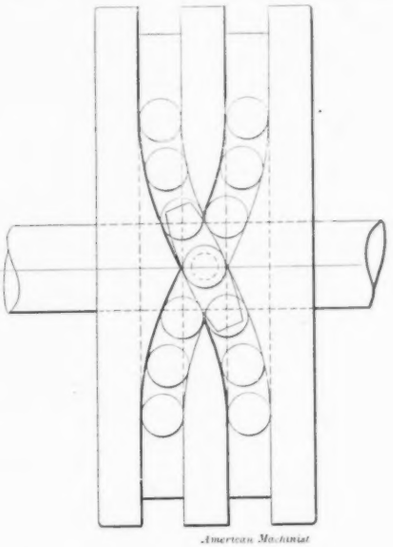

FIG. 2. TWO-REVOLUTION CAM.

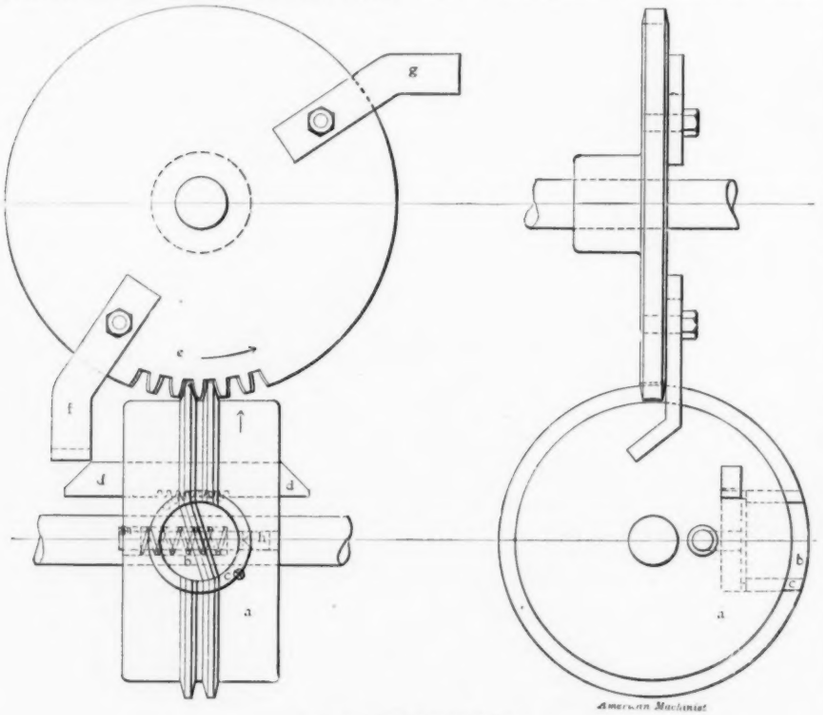

FIG. 3. REVERSING CAM.

Fig. 3 shows a cam for which I was at first refused a patent, the examiner claiming that it would not work; but in face of the fact that it had been made and did work, the patent was subsequently allowed. Its object was to stop the action of a feed plunger at predetermined intervals, the movement of the plunger being effected by another cam not shown. The cam is, in a sense, a combination and modification of those shown in Figs. 1 and 2. It gives a step-by-step motion, as in the case of Fig. 1, and reverses this motion as in the case of Fig. 2; but the reversal, instead of being on the succeeding revolution, as in the case of Fig. 2, may be made to take place after any desired number of revolutions.

The cam *a* contains a switch *b*, which is let into a recess, as shown. It is held in place by a ring *c*, and has at its inner end a series of teeth which are engaged by the rack *d*. At each revolution of the cam the die *e* is turned the width of a tooth, and at the completion of the movement one or the other of dogs *f g* engages the rack, pushes it endwise and reverses the switch; thus, on the succeeding revolu-

tion, reversing the motion of *e*. A spring-latch *h*, engaging notches in the switch, holds it in place. The dogs *f g* were mounted in a T-slot, and the reversal could thus be effected after any desired number of revolutions of the cam.

This is one of the rare reversing mechanisms that do not involve the use of springs, weights or momentum to complete the throw-over, and this is due to the fact that the throw-over is accomplished by the movement of the driving instead of the driven piece. The movement of the driven piece merely locates the position of the step *f* or *g*, the actual reversal of the switch being by the movement of *a* while *c* is at rest.

As shown, the device is not mechanically perfect, as regards the action of the teeth on the cam surfaces, and the teeth are limited in thickness and must be rounded to enable them to engage properly. Nevertheless, the arrangement worked satisfactorily. With a sufficiently coarse pitch, the gear could be made in the form of a disk, with properly shaped rollers for teeth, and this construction would, no doubt, be better than the one shown.

Personal.

United States Consul Marshal Halstead, of Birmingham, is home on a visit.

B. G. Koether, former purchasing agent of the Hyatt Roller Bearing Co., of Harrison, N. J., has left the purchasing department to become assistant sales manager of that concern.

Obituary.

Mrs. Sarah A. Moss, mother of Thos. D. West, died in Cleveland, October 26. Mrs. Moss was born in Manchester, England, in 1831, and was a first cousin of the late Dr. Michael Faraday, the famed scientist.

Business Items.

The John B. Morris Foundry Company, Cincinnati, Ohio, has recently purchased the entire plant of Roos & Mill, of Cincinnati, and will manufacture a full line of drills.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad st., New York.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Will pay 25 cents each for AMERICAN MACHINISTS of Sept. 22, 1904, and Feb. 2, 1905. S. A. Moss, G. E. Co., West Lynn, Mass.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Agency for N. Y. city wanted for meritorious articles for steam users and metal trades; must be first class. "J. C. S.," care AM. M.

Draftsman.—Drawings, tracings, plans, details, Patent Office drawings, and machinery designed. Address P. O. Box 167, Brooklyn, N. Y.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Wanted: Salesmen who call on machine shops and tool rooms to carry a new article as side line. Barrington Tool Co., Great Barrington, Mass.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted to Purchase—One gear cutter that will cut a gear wheel 71 in. in diameter, 10 in. face, 2¼ in. circular pitch or smaller; a second-hand machine in good order would be considered. Write the Ottumwa Iron Works, Ottumwa, Iowa.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

For Sale.

Complete mechanical course, International Correspondence School; will sell cheap. Box 790, AMERICAN MACHINIST

Business Opportunities.

A prosperous foundry and machine works in Atlanta, Ga., desires to arrange with manufacturers or patentees for the right to manufacture staple articles of steel and iron suitable for sale in the South. Box 787, AM. M.

Wanted—Practical accountant and business man as treasurer of an established manufacturing business; must be able to show a successful record as accountant and office man, and invest from $5,000 to $10,000 in stock of company. Address, with full particulars of experience, ability and references, "J. B.," care AMERICAN MACHINIST.

Wanted—An experienced foundryman to join others in the purchase and operation of an established job foundry with an assured tonnage of 100 to 150 tons per month; must be able to show a successful record and invest from $5,000 to $10,000. Address, with full details of experience in mixing metals, managing help, references, etc., "G. P. M.," AM. M.

For Sale—A well-established, paying, metal-working plant in important manufacturing center; superior shipping facilities; equipped with best up-to-date machinery; good, substantial, well-lighted brick building and perfect site. Large orders in hand. Price $75,000 complete, or would sell large interest to good business man or capable, active shop superintendent. Reason for selling, advanced age and ill health of proprietor. Full particulars to interested parties on application. Address "Opportunity," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Mechanical draftsman, age 32, technically educated, 5 years' drafting and 7 years' machine shop experience, at present employed, would like to make a change, preferring a position where he would not be confined to the board, such as master mechanic or assistant superintendent. Box 792, AMER. MACHINIST.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

MASSACHUSETTS.

Mechanical draftsman, with 13 years' shop and drafting experience, designer with ability, desires position; will go anywhere. Box 787, AMERICAN MACHINIST.

Mechanical draftsman wants position; 12 years' experience as designer on gate valves, fire hydrants, filtration and general waterworks specialties. "G.," Box 786, AM. M.

NEW JERSEY.

Position wanted by draftsman, 35, with 18 years' experience in general designing. Box 778, AMERICAN MACHINIST.

Mechanical engineer wants position; age 25; practical and technical training; experienced gas and oil engines; drafting, installation, testing. Box 780, AMER. MACH.

NEW YORK.

Position as superintendent or manager; young man with A1 record, good executive and business abilities; correspondence treated confidential. Box 788, AMER. MACHINIST.

First-class mechanical draftsman wants to change position; long experience on Corliss engines and gas motors; New York or vicinity preferred. Box 783, AMERICAN MACHINIST.

Manager and superintendent of factory; now open for engagement; familiar with modern office, shop and foundry methods; if not willing to pay for high-class man, don't answer. "Manager," care AMER. MACHINIST.

Designer, graduate M. E. (age 30); 2 years shop, 9 years office, on special and small machinery, instruments, jigs, fixtures and experimental work; practical and inventive man; hustler; location immaterial. Box 784, A. M.

Executive position in engineering department or works wanted by mechanical engineer with 10 years' experience in machine design and construction; expert on hoisting and conveying machinery. Box 781, AM. MACH.

OHIO.

Position wanted by a first-class metal pattern maker; understands all branches thoroughly, also molding machines. Box 785, AMERICAN MACHINIST.

PENNSYLVANIA.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Superintendent, with executive ability and experienced in modern metal manufacture; toolmaker, with technical education; highest references from present employers. Box 724, AMERICAN MACHINIST.

As superintendent or assistant superintendent of manufacturing plant; 18 years' experience; 7 years present employer; thoroughly competent to organize or modernize; accustomed to handling 1,000 men on diversified line of small and special work; modern systems of production, costs, storekeeping and premium labor; a dividend earner; age 35; references A1. Box 783, AMER. MACHINIST.

WISCONSIN.

Position as foreman of lathe or turret lathe department, or as inspector of finished work; good references. Box 782, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

We are constantly adding to our force, and invite applications from machinists, toolmakers, diesinkers drop forgers, erectors and patternmakers, also lathe, screw machine and bench hands; in applying, please state age, experience and wages wanted. Locomotive Company of America, Bridgeport, Conn.

ILINOIS.

A large structural steel manufacturing concern in Chicago invites applications from thoroughly competent men, for position of general foreman in their shop; applicants, to receive consideration, should state fully their experience, references and present place of employment; no applications are desired from men who do not consider themselves competent to secure the highest salaries paid for this class of service. Box 744, AM. MACH.

INDIANA.

Wanted—Experienced operator for universal milling machine, also a lathe hand for accurate tool work. Box 771, AMER. MACH.

Wanted—Two first-class operators for Jones & Lamson screw machines. Must be able to operate machine to full capacity. Call or address, Nordyke & Marmon Co., Indianapolis, Ind.

IOWA.

Wanted—Machine shop foreman, experienced in agricultural implement work and capable of handling men and machinery by up-to-date methods and producing work at minimum cost; state age, experience, references, salary wanted. Address P. O. Box 5, Newton, Iowa.

Wanted—A first-class patternmaker for light high-grade work; must thoroughly understand fitting up patterns for molding machines; factory is situated in an up-to-date town of 20,000 population; married man preferred; kindly give references and salary expected; an excellent opportunity for the right man. Box 769, AMERICAN MACHINIST.

Wanted—Blacksmith shop foreman, for agricultural implement work, experienced in general blacksmithing, sheet metal work, punching, shearing and bulldozer work; capable of handling men and machinery by up-to-date methods and producing work at minimum cost; state age, experience, references, salary wanted. Address P. O. Box 5, Newton, Iowa.

MARYLAND.

Toolmakers wanted on automobile work; competent toolmakers; must be first-class men who will appreciate steady employment. Address Pope Manufacturing Company, Hagerstown, Md.

MASSACHUSETTS.

Machinists Wanted—We are increasing our force and need good, all-round men on special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

NEW JERSEY.

Wanted—By manufacturing concern near Newark, two mechanical draftsmen at once; must be accurate; permanent position. Box 789, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

NEW YORK.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 708, AMER. MACHINIST.

Wanted—First-class draftsmen for jig and fixture work on light interchangeable parts; also men experienced in design of dies for light sheet-metal work Address Box 791, AMERICAN MACHINIST.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—At once, foreman patternmaker, experienced on medium and heavy pump and engine work; give details of past engagements and duration of same, wages received and expected; young man preferred. Address "State," care AMERICAN MACHINIST.

Wanted—Mechanical draftsman for leading position; one experienced on high-speed and Corliss engine work; one who can direct work and others, is familiar with and can carry out systematic methods; to receive consideration, give full details of past experience, salary received and expected. Address "Capital," care AMERCAN MACHINIST.

Wanted—Superintendent to take charge of an established and up-to-date plant manufacturing a line of A1 machine tools; must have push, energy and good executive ability, also be well up in modern machine shop practice; only men of ability need apply; state age, experience, salary expected, with references; all correspondence will be treated strictly confidential. Address Box 726, A. M.

Wanted—An up-to-date foreman to take entire charge of a concern in New York city, manufacturing various kinds of hardware in iron, steel and brass; who can manage from 35 to 40 men and boys, and be able to systematize, economize and be a hustler; one who has a job an dis looking for a better one and those out of work need not apply; state age, salary expected, and where now employed. Box 789, A. M.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMER. MACHNIST.

Wanted—Machinists and patternmakers. We are constantly adding to our force, and invite applications from machinists and patternmakers, preferably those accustomed to engine work. Shepherd Engineering Company, Franklin, Pa.

Wanted, at Once—Designing draftsman; only those who have had actual experience in designing Corliss or similar engines considered; give previous engagements, duration, compensation received, how soon can come and salary required. Shepherd Engineering Co., Franklin, Pa.

Wanted—A man of good business and executive ability and some capital, to take the management of a business requiring the introduction and putting on the market a new invention of undoubted merit and a large field of trade; it has been sufficiently introduced to prove it to be a success and a money-maker; have plant complete to manufacture. Box 750, AMERICAN MACHINIST.

VERMONT.

Wanted—Young man, technical graduate, with machine shop experience, for assistant engineer. Vermont Marble Co., Proctor, Vt.

VIRGINIA.

Wanted—Machinists with experience in building elevator machinery. The J. B. Westbrook Foundry and Machine Company, Danville, Va.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co. 22
Acme Machinery Co. 34
Adams Co., The. 9
Albro-Clem Elevator Co. 106
Allington & Curtis Mfg. Co. . . . 89
Almond Mfg. Co., T. R. 103
American Gas Furnace Co. . . . 14
American Pulley Co. 31
American Tool Works Co. . . . 8
American Tool & Mach. Co. . . . 98
American Tube & Stamping Co. 109
Armstrong Bros. Tool Co. . . . . 30 and 85
Auburn Ball Bearing Co. 103
Aurora Tool Works. 98
Automatic Machine Co. 108

Baird Machinery Co. 88
Baker Brothers. 28
Baldwin Chain & Mfg. Co. 90
Baldwin Steel Co. 100
Ball Bearing Co. 34
Barnes Co., B. F. 85
Barnes Co., W. F. & John. . . . 14
Barnett Co., G. & H. . . 4th Cover
Bartlett, E. E. 92
Bay State Stamping Co. 85
Bay State Tap & Die Co. 97
Beaman & Smith Co., The. . 15 and 102
Becker-Brainard Milling Machine Co. 13
Bertram & Sons Co., Ltd., John. 14
Besly & Co., Chas. H. 91
Bethlehem Fdry. & Mach. Co. 105
Bickford Drill & Tool Co. 10
Bignall & Keeler Mfg. Co. 97
Bilgram, Hugo. 34
Billings & Spencer Co. 95
Binsse Mach. Co. . . . . 34 and 79
Birdsboro Steel Foundry & Machine Co. 93
Blaisdell Machinery Co. 95
Blanchard Mach. Co. 34
Bliss Co., E. W. 25
Blount Co., J. G. 22
Boker & Co., Hermann. 83
Booth, Wm. M. 90
Boston Gear Works. 106
Boynton & Plummer. 101
Bradford Machine Tool Co. . . . 5
Bridgeford Mach. Tool Works. 16
Bridgeport Safety Emery Wheel Co. 108
Bristol Co. . . . . 4th Cover
Brown-Cochran Co. 98
Brown & Co., R. H. 102
Brown & Sharpe Mfg. Co. . . . 73 and 4th Cover
Brown Hoisting Mach. Co. . . . 104
Buffalo Forge Co. . . . . 4th Cover
Builders Iron Foundry. . 3d Cover
Bullard Auto. Wrench Co. . . . 30
Bullard Machine Tool Co. . . . 32
Bury Compressor Co. 99
Butler, A. G. 97

PAGE

Caldwell & Son Co., H. W. . . . 107
Carborundum Co., The. 25
Card Mfg. Co., S. W. 17
Carpenter Tap & Die Co., J. M. 87
Case Mfg. Co. 104
C & C Electric Co. 27
Chambersburg Engr. Co. 85
Chattanooga Machinery Co. . . . 88
Chicago Rawhide Mfg. Co. . . . 106
Christensen, N. A. 99
Cincinnati Machine Tool Co. . 109
Cincinnati Milling Mach. Co. . 6 and 7
Cincinnati Planer Co. 9
Cincinnati Shaper Co. 110
Clark Cast Steel Cement Co. . 99
Clark, Jr., & Co., Jas. 96
Cleveland Auto. Mach. Co. . . 18
Cleveland Crane & Car Co. . . 104
Cleveland Pneumatic Tool Co. 99
Cleveland Stone Co. 90
Cleveland Twist Drill Co., The. . . . . 4th Cover
Clough, R. M. 107
Coates Clipper Mfg. Co. 90
Coes Wrench Co. 23
Colburn Machine Tool Co. . . . 22
Columbus Machine Co. 98
Cook Co., Asa S. 104
Cornell, J. B. & J. M. 100
Crescent Forgings Co. 93
Cresson Co., Geo. V. 105
Crocker-Wheeler Co. 28
Crosby Steam Gage & Valve Co. 17
Cumberland Steel Co. 97
Curtis & Co. Mfg. Co. 104
Curtis & Curtis Co. 89
Cushman Chuck Co. 102
Cutler-Hammer Clutch Co. . . . 28

Dallett Co., Thomas H. 90
Davis, Rodney. 106
Desmond-Stepnan Mfg. Co. . . 108
Detrick & Harvey Mach. Co. . 101
Diamond Machine Co. . . 3d Cover
Dill Machine Co., T. C. 22
Dixon Crucible Co., Joseph. . . 99
Dodge & Day. 90
Dreses Machine Tool Co. 92
Druckllieb, C. 99
Dwight Slate Mach. Co. 106

Earle Gear & Mach. Co. 97
Eberhardt Bros. Machine Co. 106
Eck Dynamo & Motor Wks. . . 28
Electro-Dynamic Co. 29
Errington, F. A. 103
Evans Friction Cone Co. 108
Excelsior Needle Co. 88

Fairbanks Co. . . . . 33 and 88
Farrel Fdry. & Machine Co. . 100
Fawcus Machine Co. 107
Fellows Gear Shaper Co. 106
Fenn-Sadler Machine Co. 97
Firth-Stirling Steel Co. 100

PAGE

Fitchburg Machine Works. 91
Foos Gas Engine Co. 98
Fosdick Machine Tool Co. 15
Franklin Mfg. Co. 94

Garvin Machine Co., The. 95
Geier Co., P. A. 102
General Electric Co. 26
General Mfg. Co. 89
General Pneumatic Tool Co. . 31
Geometric Tool Co. 29
Gilmore Electric Co. 28
Gleason Works. . . . . 4th Cover
Goldschmidt Thermit Co. 100
Gorton Machine Co., Geo. 85
Gould & Eberhardt. 77
Graham Mfg. Co. 103
Grant Gear Works. 106
Gray & Prior Machine Co. . . . 99
Gray Co., G. A. 34
Greaves, Klusman & Co. 101
Greenfield Machine Co. 108
Greenwald Co., I. & E. 107

Hammacher, Schlemmer & Co. 79
Hampden Corundum Wheel Co. 108
Harrington, Son & Co., Inc., Edw. 109
Hartford Steam Boiler Insp. & Ins. Co. 98
Heald Machine Co. 97
Hendey Machine Co. 81
Henley Publishing Co., Norman W. 85
Henry & Wright Mfg. Co. 108
Heppenstall Forge & Knife Co. 89
Hess-Bright Mfg. Co. 33
Hill, Clarke & Co. 86
Hilles & Jones Co. 88
Hinckley, F. C. 97
Hisey-Wolf Machine Co. 99
Hoefer Mfg. Co. 14
Hoggson & Pettis Mfg. Co. . . . 102
Horton & Son Co., E. 102
Horsburgh & Scott Co. . 4th Cover
Hunt Co., C. W. 104
Hunt & Co., Robt. W. 97
Hyatt Roller Bearing Co. 98

Ide & Sons, A. L. 86
Ingersoll Milling Mach. Co. . . 89
Ingersoll-Rand Co. 20
International Specialty Co. . . . 108
Iroquois Machine Co. 89

Jacobs Mfg. Co. 102
Jacobson Mach. Mfg. Co. 98
Jantz & Leist Electric Co. . . . 28
Jeffrey Mfg. Co., The. 86
Jenkins Brothers. 99
Johnson Machine Co., Carlyle. 83
Jones & Lamson Machine Co. 12 and 34
Keep, W. J. 92
Kelsey, Duane J. 97
Kent & Co., Edwin R. 100
Kilbourne & Jacobs Mfg. Co. . . 100
King Machine Tool Co. 90

PAGE

Landis Machine Co. 108
Landis Tool Co. 75
Lapointe Machine Tool Co. . . 100
Le Blond Machine Tool Co., R. K. . . . . 4th Cover
Le Count, Wm. G. 102
Link-Belt Engineering Co. . . . 24
Lockwood, Arthur J. 101
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The. . . 89
Lucas, J. L. 97
Lunkenheimer Co., The. 99

McBarron Co. 89
McCabe, J. J. . . . . 30 and 86
McGlehan & Co., C. H. 92
McInnes Steel Co. 100
Manhattan Automobile School. 101
Maris Bros. 104
Marshall & Huschart Mch. Co. 87
Massachusetts Saw Works. . . . 102
Massey Machine Co. 95
Mechanical Accountant Co. . . 92
Merrell Mfg. Co. 90
Merritt & Co. 90
Mersfelder Pattern Co. 101
Mietz Iron Fdry. & Mach. Works, August. 98
Millers Falls Co. 89
Miner & Peck Mfg. Co. 97
Moore Co., Franklin. 104
Morse Chain Co. 1
Morse Twist Drill & Mach. Co. 33
Motch & Merryweather Mchry. Co. 87
Mueller Mach. Tool Co. 101
Mutual Machine Co. 86

National-Acme Mfg. Co. 110
National Corundum Wheel Co. 108
New Britain Machine Co. . . . 90
New Era Gas Engine Co. . . . 98
New Haven Mfg. Co. 85
New Process Raw Hide Co. . . 107
New Process Twist Drill Co. . 97
Newton Mach. Tool Wks., Inc. 11
New York Machinery Depot. . . 88
Nicholson File Co. 17
Nicholson & Co., W. H. 103
Niles-Bement-Pond Co. . . . . 86, 88, 111, 112, 113 and 114
Northern Electrical Mfg. Co. . 27
Northern Engineering Works. 104
Norton Emery Wheel Co. 33
Norton Grinding Co. 16
Nuttall Co., R. D. 106
Nutter, Barnes & Co. 99

Obermayer Co., S. 101
Oil & Waste Saving Mach. Co. 92
O. K. Tool Holder Co. 103
Oneida National Chuck Co. . . . 102
Owen Machine Tool Co. 107

Parker Co., Chas. 103
Patterson, Gottfried & Hunter, Ltd. 94
Pawling & Harnischfeger. 104

PAGE

Paxson Co., J. W..... 30
Philadelphia Bourse..... 98
Philadelphia Gear Works.....106
Phillips & Sons Co., F. R..... 92
Phoenix Mfg. Co..... 97
Poole Co., J. Morton..... 22
Potter & Johnston Mach. Co. 81
Pratt Chuck Co..... 102
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co... 86
Prentiss Vise Co.....103
Pressed Steel Mfg. Co..... 97

Ransom Mfg. Co..... 97
Reed Mfg. Co.....103
Reeves Pulley Co..... 25
Reichhelm & Co., E. P..4th Cover
Reliance Machine & Tool Co.. 88
Rivett-Dock Co.... ....3d Cover
Rivett Lathe Mfg. Co...3d Cover
Robbins, L.....100
Rogers, Boat, Gage & Drill Works, John M.....101
Rowbottom Machine Co..... 85

Safety Emery Wheel Co.....108
Saunders' Sons, D..... 89
Sawyer Gear Works.....106

PAGE

Schieren & Co., Chas. A..... 28
Schumacher & Boye..... 9
Schwerdtle Stamp Co..... 92
Scranton & Co..... 95
Sebastian Lathe Co..... 30
Sellers & Co., Inc., William.. 34
Seneca Falls Mfg. Co.....109
Shaw & Co.....101
Shelby Steel Tube Co.....100
Shultz Belting Co..... 30
Sibley Machine Tool Co..... 99
Simonds Mfg. Co.....106
Skinner Chuck Co.....102
Slocomb Co., J. T..... 92
Smith & Mills..... 90
Speed Changing Pulley Co...103
Spicer Universal Joint Mfg. Co..... 97
Sprague Electric Co..... 29
Springfield Machine Tool Co.. 91
Standard Engineering Works. 89
Standard Gauge Steel Co.....107
Standard Tool Co..... 24
Stanley G. I. Elec. Mfg. Co.. 96
Stark Tool Co..... 88
Starrett Co., L. S..... 93
Steptoe Shaper Co., John.... 85
Stevens, F. B.....101

PAGE

Stoever Fdry. & Mfg. Co.... 89
Struthers-Wells Co.... 98
Sturtevant Co., B. F..... 23
Syracuse Raw Hide Co.....106

Taylor-Wilson Mfg. Co.....106
Three Rivers Tool Co..... 14
Toledo Machine & Tool Co....105
Toomey, Frank..... 88
Triumph Electric Co..... 28
Trump Brothers Machine Co.102

Underwood & Co., H. B.....104
Union Twist Drill Co..... 77
U. S. Foundry & Sales Co....100

Vanderbeek Tool Works.....103
Vandyck Churchill Co..... 19
Veeder Mfg. Co..... 85
Vickers, Sons & Maxim.....101
Vitrified Wheel Co..... 97

Wallace Supply Co..... 97
Ward & Sons, Edgar T.....100
Warner Instrument Co..... 94
Warner & Swasey Co..... 75
Watson-Stillman Co.... 105

PAGE

Waterbury Farrel Foundry & Mach. Co..... 103
Webster & Perks Tool Co..... 89
Wells Bros. Co..... 31
West Haven Mfg. Co...4th Cover
Westinghouse Elec. & Mfg. Co. 27
Westmacott Co., J. M..... 98
Whitcomb-Blaisdell Machine Tool Co..... 21
Whitman & Barnes Mfg. Co... 94
Whitney Mfg. Co..... 71
Whiton Mach. Co., D. E.....102
Wiley & Russell Mfg. Co..... 92
Wiley & Sons, John..... 34
Williams & Co., J. H..... 90
Wilmarth & Morman Co.....108
Windsor Machine Co..... 88
Winkley Co..... 85
Wood's Sons, T. B..... 85
Woodward & Powell Planer Co.... 105
Worcester Mach. Screw Co...102
Wormer Machinery Co., C. C. 87
Wright, Harold A..... 97
Wyke & Co., J..... 87
Wyman & Gordon.....4th Cover

Yale & Towne Mfg. Co.....104

Classified Index of Articles Advertised.

Abrasive Materials
Abasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
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See Hoists, Hand.

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Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
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Gisholt Mach. Co., Madison, Wis.
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McCabe, J. J., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.

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Starrett Co., L. S., Athol, Mass.

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Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Die Molded
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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Centering Machines—*Cont'd*
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Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartfrod, Ct.

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Booth, Wm. M., Syracuse, N. Y.

Chisels, Cold
Anderson & Sons Co., Detroit, Mich.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
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Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Oneida National Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

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Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

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American Tool & Mach. Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
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Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
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Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

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Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
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Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold O., New York.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Counterbores
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Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

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Almond Mfg. Co., T. R., Brooklyn, N Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

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Gisholt Mach. Co., Madison, Wis.
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Speed Changing Pulley Co., Indianapolis, Ind.

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Ingersoll-Rand Co., New York.

Couplings, Shaft
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Caldwell & Son Co., H. W., Chicago, Ill.
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Davis Mach. Co., W. P., Rochester, N. Y.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

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Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co, Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

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Link-Belt Engineering Co., Philadelphia, Pa.

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Obermayer Co., S., Cincinnati, O.
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Stevens, F. B., Detroit, Mich.

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Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

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Warner Instrument Co., Beloit, Wis.

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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
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Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
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Davis Mach. Co., W. P., Rochester, N. Y.
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Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
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Vandyck Churchill Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
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Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mach. Co., Bridgeton, N. J.
Kent & Co., Edwin R., Chicago, Ill.
Toledo Mach. & Tool Co., Toledo, Ohio.

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Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
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Pratt & Whitney Co., Hartford, Conn.
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Winkley Co., Hartford, Conn.

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Universal Drafting Mach. Co., Cleveland, O.

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Ingersoll-Rand Co., New York.

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Pratt & Whitney Co., Hartford, Conn.

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American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
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Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
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Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
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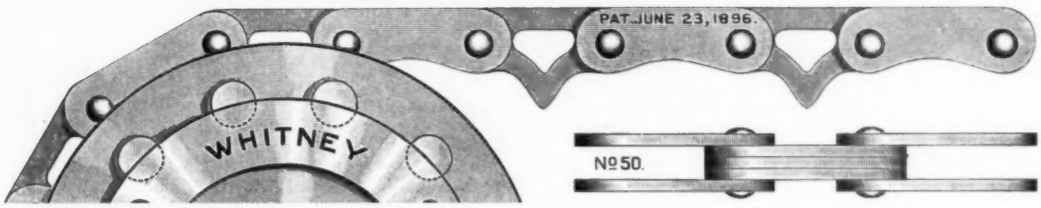
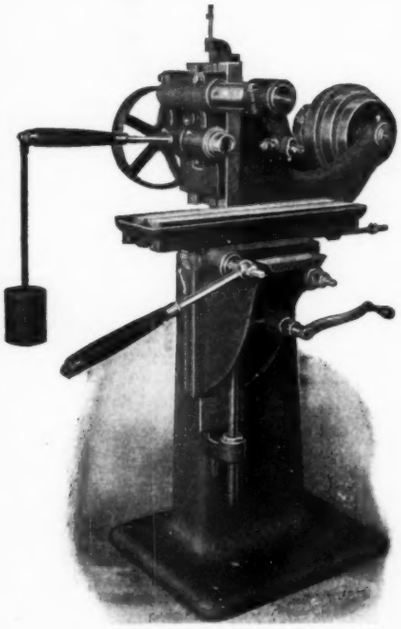
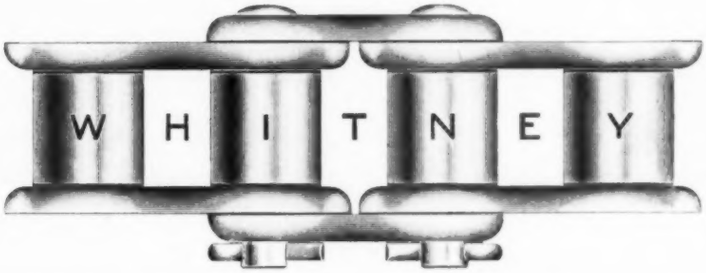
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.

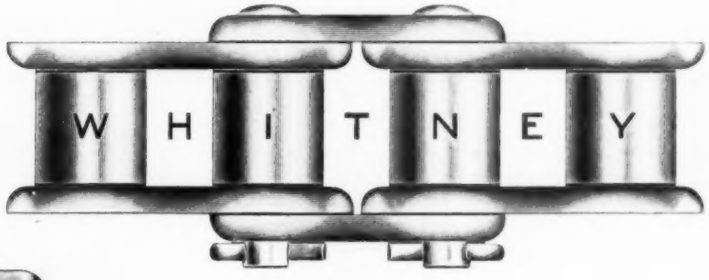


"WIZARD" Chains and Sprockets—Patented

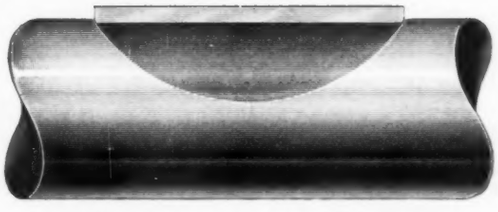




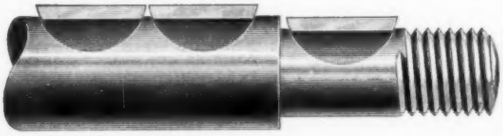
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

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Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Sprague Elec. Co., New York.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
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Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

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See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.

Emery Wheel Dressers
Continued
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

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Merritt & Co., Philadelphia, Pa.

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Dodge & Day, Philadelphia, Pa.
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

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Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. A., Wilkesbarre, Pa.

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Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
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Boynton & Plummer, Worcester, Mass.
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Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

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Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
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Heppenstall Forge & Knife Co., Pittsburg, Pa.
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American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
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American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadephia, Pa.
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Sturtevant Co., B. F., Boston, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

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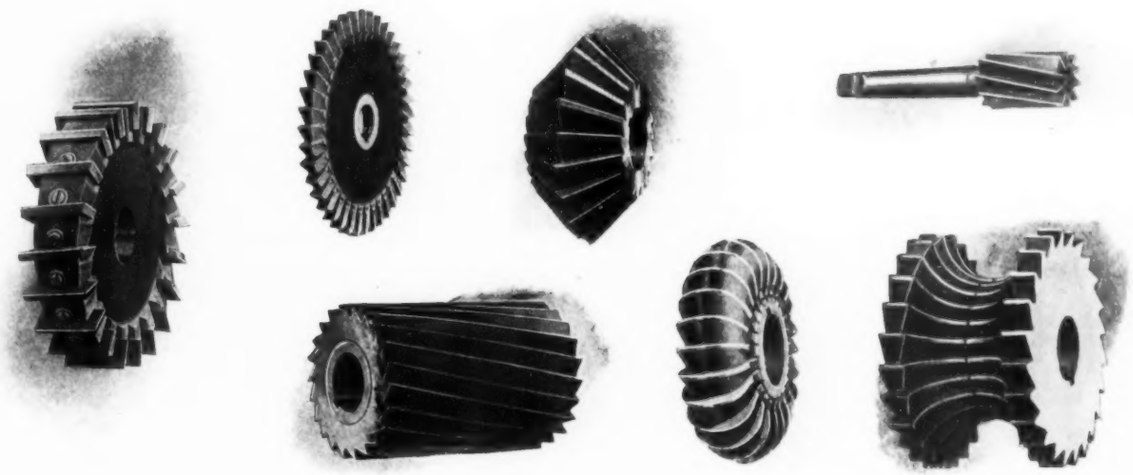

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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
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Bilgram, Hugo, Philadelphia, Pa.
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Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
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Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
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Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
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Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
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Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwad Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.,
Sprague Elec. Co., New York.
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Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

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Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

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Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.

Grinders, Internal
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.

Grinders, Tool —*Continued*
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & Jno., Rockford Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneu. Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Hammers, Drop —*Continued*
Toledo Mach. & Tool Co., Toledo, Ohio.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
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Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
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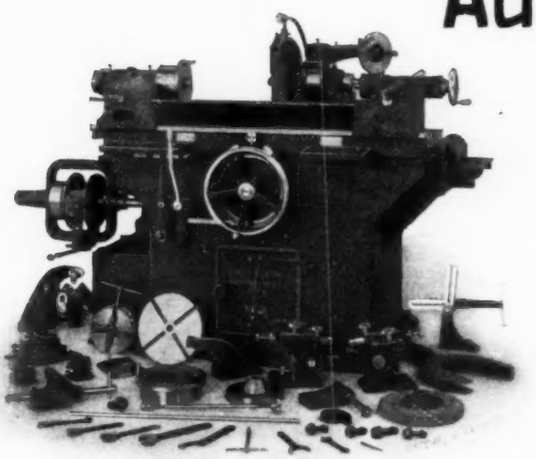
Landis No. 2 Universal With Automatic Feeds



12 Inch Swing. 32 Inches Between Centers.

is an indispensable tool for grinding and regrinding spiral—solid and inserted tooth surface mills. As regularly equipped it has no near competitor for grinding spindle shafts—straight and taper, sides of saws, plates and all work that can be carried by a face plate or chuck—internal or external. For tool room work it is also a good one. By the use of special attachments a great variety of additional grinding operations can be performed, which includes every operation of grinding such parts as straight and taper reamers.

If this doesn't happen to be the machine you require, ask about the other Landis types, of which there are a large variety.

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Many important features not embodied in other similar machines: Automatic Chuck—handles stock of any shape. Roller Feed. Automatic Feed—gear driven—changes instantly obtainable. Independent Adjustable Stops for turret. Many others—full particulars upon request.

Complete Line of
TURRET LATHES
and
BRASS WORKING
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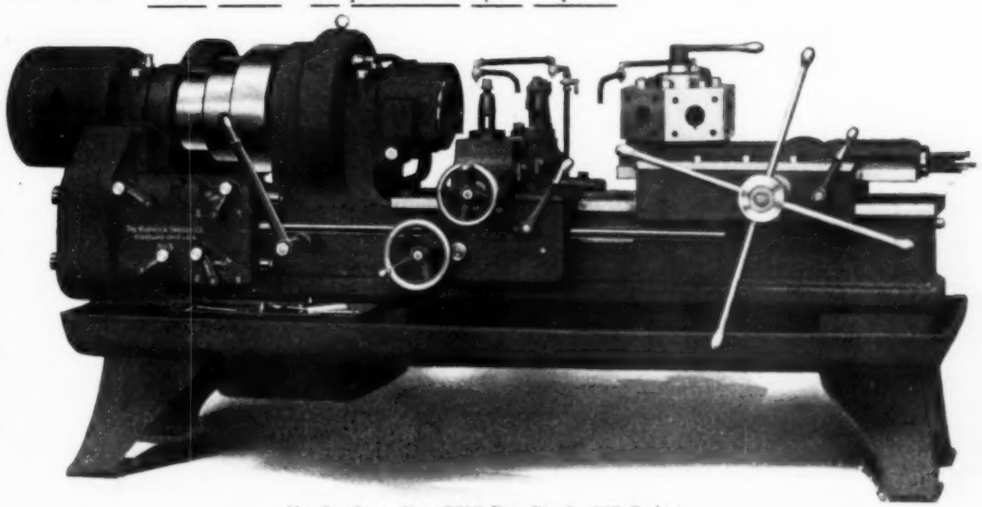

No. 8—Capacity: 3⅝" Bar Stock: 20" Swing.

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Warner Instrument Co., Beloit, Wis.

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Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

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Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

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Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

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Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
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Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

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Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear
Phillips & Sons Co., F. R., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

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Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
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Gilmore Elec. Co., So. Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
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American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
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Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
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Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

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Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

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Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

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Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.

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Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

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Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

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Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.
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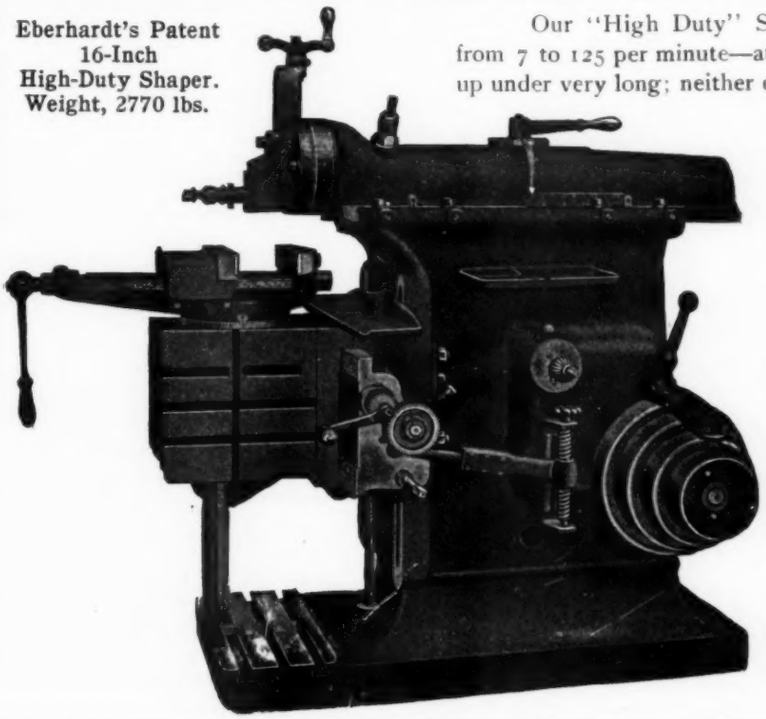
Eberhardt's Patent 16-Inch High-Duty Shaper. Weight, 2770 lbs.



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The superiority of the Gould & Eberhardt Shaper is accounted for in its many features, such as "Double Train" Gear Drive and Extension Base and Table Support.

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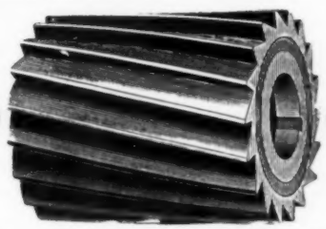

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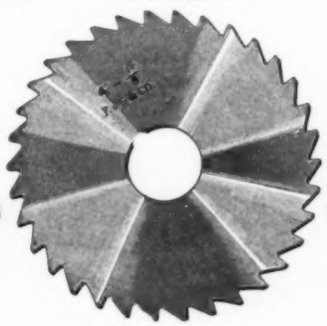

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Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
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Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

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Gould & Eberhardt, Newark, N. J.
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Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Mumford Co., E. H., Phila., Pa.
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Crocker-Wheeler Co., Ampere, N. J.
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Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Jantz & Leist Elec. Co., Cin., O.
Northern Electric Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
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Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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See Bolt and Nut Machinery.

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Oil & Waste Saving Mach. Co., Philadelphia, Pa.

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Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic
Watson-Stillman Co., New York.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

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Prentiss Tool & Supply Co., New York.
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Rowbottom Machine Co., Waterbury, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
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Reed Mfg. Co., Erie, Pa.
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Standard Tool Co., Cleveland, O.

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Gray Co., G. A., Cincinnati, O.

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Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bilgram, Hugo, Philadelphia, Pa.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg Mass.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
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Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
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Precision Machinery
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Faneuil Watch Tool Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

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Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

Presses, Forging
Niles-Bement-Pond Co., New York.

Presses, Hand
Bliss Co., E. W., Brooklyn, N. Y.

Presses, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Watson-Stillman Co., New York.

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Automatic Mach. Co., Bridgeport, Conn.
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Billings & Spencer Co., Hartford, Conn.
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Chambersburg Engineering Co., Chambersburg, Pa.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
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Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Screw
Barnes Co., W. F. & Jno., Rockford, Ill.

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Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

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Hill Pub. Co., New York.

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American Tool & Mach. Co., Boston, Mass.
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Cresson Co., Geo. V., Phila., Pa.
Eastern Mchy. Co., New Haven, Conn.
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Patterson, Gottfried & Hunter, Ltd., New York.
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Niles-Bement-Pond Co., New York.
Vandyck Churchill Co., New York.

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Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
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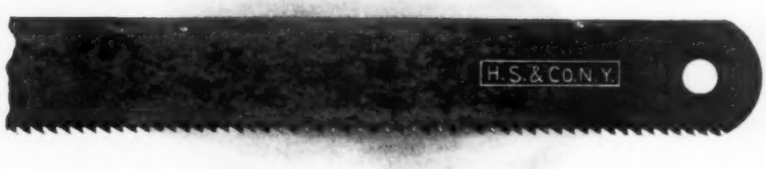

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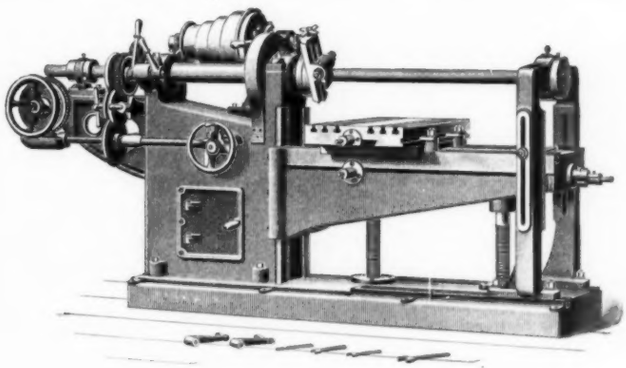

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Saws, Metal Band
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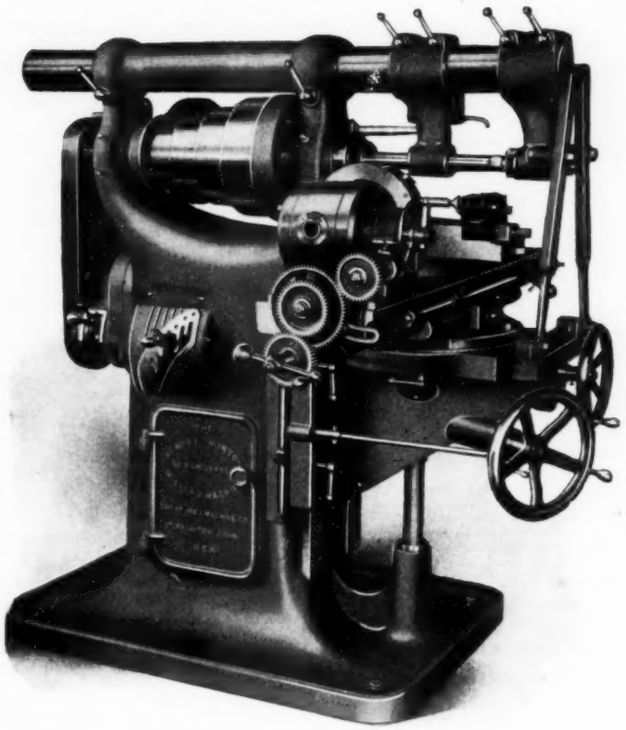

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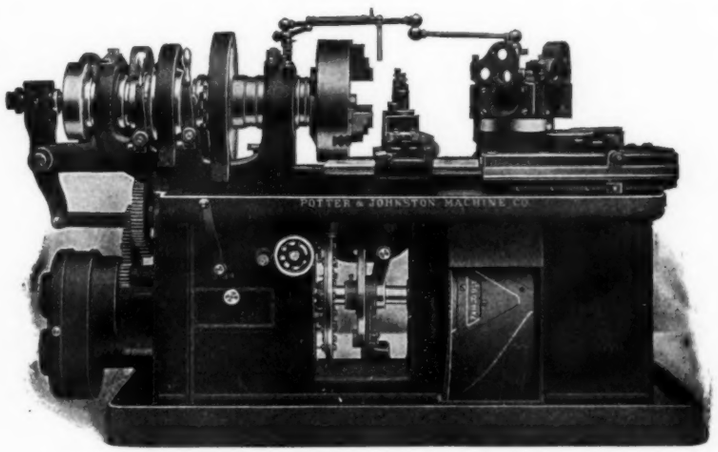

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Marshall & Huschart Mach. Co., Chicago, Ill.
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Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Tempering Powders
Phillips & Sons Co., F. R., Philadelphia, Pa.

Testing Machines
Keep, W. J., Detroit, Mich.

Thermit
Goldschmidt Thermit Co., New York.

Thermometers
Bristol Co., Waterbury, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rogers, Boat, Gauge & Drill Wks., Gloucester City, N. J.

Time Recorders
Simplex Time Recorder Co., Gardner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Bown Machine Co., Battle Creek, Mich.
Hill-Standard Mfg. Co., Anderson, Ind.
O. K. Tool Hider Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Mchy. Co., New Haven, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Tuohy Bros., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Brown Hoisting Mchry. Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.
Shelby Steel Tube Co., Pittsburg, Pa.
Standard Welding Co., Cleve., O.
Ward & Sons, Edgar T., Boston, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turrets, Carriage
Blount & Co., J. G., Everett, Mass.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Marshall & Huschart Machy. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twst Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Ward & Sons, Edgar T., Boston, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Machine Co., Hartford, Conn.
Spicer Reversible Joint Mfg. Co., Plainfield, N. J.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Valves, Cylinder Relief
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Valves, Safety Pop
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Vises, Drill
Graham Mfg. Co., Prov., R. I.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Parker Co., Chas., Meriden, Conn.

Vises, Metal Workers' *Continued*
Reed Mfg. Co., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.

Vises, Universal Machine
Graham Mfg. Co., Prov., R. I.

Vise Stands, Portable
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Electric Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Cleveland, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Wire and Cables
General Electric Co., New York.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.
Prentiss Tool & Supply Co., New York.

Wood Working Machinery
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Whitman-Barnes Mfg. Co., Chicago, Ill.
Wyman & Gordon, Worcester, Mass.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Bullard Auto. Wrench Co., Providence, R. I.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.
Williams & Co., J. H., Brooklyn, N. Y.

Making the Pattern and Mold for a Bed for a Power Press.

BY R. H. PALMER.

In building special machinery, one of the by-no-means small items, when castings are required, is the cost of patterns. Where a number of machines are built alike, the patterns are to a certain extent standard, as the machines may break down, or more may be built. But where only one set of castings is wanted, the question arises, Which way can the patterns be made the cheapest?

A pattern which is well put together,

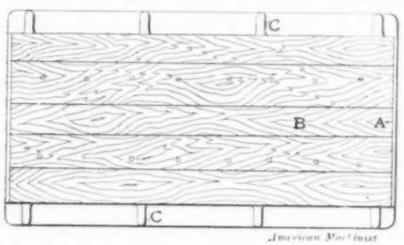


FIG. 1. TOP VIEW OF THE PATTERN.

drafted aright and well finished, is to patternmakers and foundrymen a pleasant sight; but these cost money, and when only one casting is desired from a large pattern, add to the cost. Yet many times a large pattern from which but one casting is wanted can be made so the molder may obtain a casting from it, and by letting him round the corners—thus avoiding fillet work—and with the aid of a cheaply made core-box, core out the inside of casting, many castings may be made with an inexpensive pattern; while the pattern itself may be made to answer all purposes, though not blacked, rubbed down and finely finished, and when the casting is obtained the pattern may be taken apart and the lumber used for other pattern work. To the patternmaker who has been accustomed to make good, serviceable patterns, and who has been accustomed to take pride and pleasure in his work, the making of these cheap patterns is a job he does not relish. But the question is one of economy.

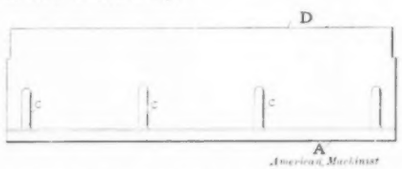


FIG. 2. SIDE VIEW OF THE PATTERN.

Look at the pattern shown in Figs. 1 and 2, some 8 feet long by 4 feet 6 inches wide and 2 feet 4 inches deep. The pattern is made a strong box, roughly ribbed on the inside to enable it to withstand inward pressure as the sand is rammed around it. The sides, or flanges, *A*, Fig. 2, are made to be drawn inwardly from the sides of the mold after the main part of the pattern, *A*, Fig. 1, has been drawn from the sand; so also are the brackets *C*, Figs. 1 and 2; therefore these require a certain amount of draft, as also do the sides of pattern *D*, Fig. 2, while the top and bottom of the pattern *B*, Fig. 3, may be rough stock.

The inside of the casting is to be ribbed to give it strength, as can be seen by following the dotted line in *A*, Figs. 4 and 5; also shown in the top view of the casting at Fig. 8. These ribs are formed between dry-sand cores.

One core-box, Fig. 6, is made, *A* showing the top view, and *B* the side view; loose pieces *C C C* are made to drop into the box, which are to change the shape of the core to form the ribs as required, making one core-box produce the eight cores wanted.

It will be seen by referring to Figs. 4 and 5, and following the dotted lines *A*, that the same core is used in corner 2 that is used in 1, and the same in 3 as in 4; so, when the core-box is fitted with the loose pieces to make No. 2, No. 1 is also made; the same with Nos. 3 and 4, while the four center cores are alike.

In all large foundries, when more or less pit-molding or work of a larger kind is made in the floor—bedded in, as we term it—the pit, or pits, are seldom out of use, and the arrangement of binders or plates in the bottom of the pit is such as will meet the general requirements of the usual class of work done by that foundry. In securing a mold in the floor, there is often more or less rigging used, which at first sight—to one unaccustomed to seeing work of this kind—seems clumsy and awkward; but it is only some of the makeshifts in use in the foundry in order to use the rigging already in the floor, and adapt it to a class of work which, on the start, it was not intended for. But the foundry finds itself with a job which must go in there, and it will cost too much to dig up and place the rigging anew for this particular case if there be but one casting required. Hence, the plates or binders are usually put in some six feet or more deep, spaced off with the bolts coming up from plate, or binders ending in an eye just under the floor surface.

When fastening down the cope, a hook bolt is used in connection with it, and when the pit is out of use the floor is left level for surface floor molding. The pit is cleaned out to the required depth for molding the pattern I have described, and a cinder bed is put in—*B*, Fig. 4—with a vent pipe *C*. The sand is rammed above it the required height and a bed made on which the pattern is to be laid.

In making a bed of this kind, some molders will ram the sand very hard up to within some ¾ inch of where the pattern is actually to come, and will then place straight-edges to form guides; will then level the sand and vent down to the cinder bed, then put on a certain amount of facing sand and pound it down a certain distance, using a strike and

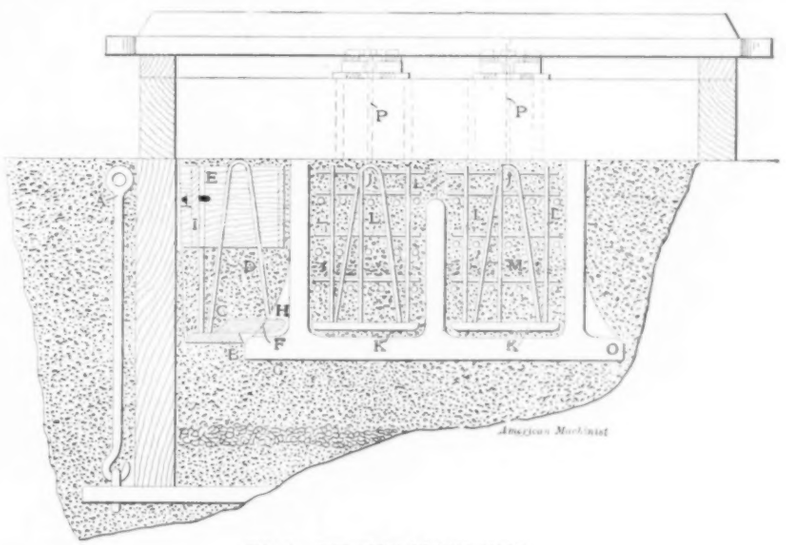


FIG. 3. END VIEW OF THE MOLD.

pieces of wood running on the straight-edges to leave the sand standing above the straight-edges the height they wish to pound down. Others will place the straight-edges, having them carefully leveled, and make up the surface the pattern is to rest on by hand after venting; while others, after venting, will place facing sand and carefully ram it with a rammer, striking off even with straight-edges and carefully slicking. In slicking a face of a mold where there is much iron to run over the surface, care should be taken not to have a hard, glassy surface. Too much finish is often as bad as not enough. Again, it is of the utmost importance that the molder remember what the strain on this surface is to be.

The face of the mold may be all right, but the ramming under it may not be firm enough, and the weight and strain on the bed more than the bed can stand; hence

when the casting is cleaned and a straightedge is laid on the surface, the casting will show that the bed of the mold has given, and the face of the casting is rounded, owing to the bed not being firm enough.

Again, the bed may be firm and the face of the mold too hard, and a scabbed casting is the result. Pounding sand is not all of a molder's trade, and the man who refers to the molder as a "pounder of sand," and tells about "our molding machine," is often a man who knows but little of what molding consists of, and while showing visitors through a foundry says, "There is where they pour the iron in," and points to a riser, can hardly blame the "sand pounder" if his face lights up a little. To be a good molder requires, among other virtues, good judgment and something besides horse sense.

The bed being made, the pattern is placed, and sand is rammed against the ends of the pattern; the gates *D*, Fig. 4, being placed as shown, also the upright

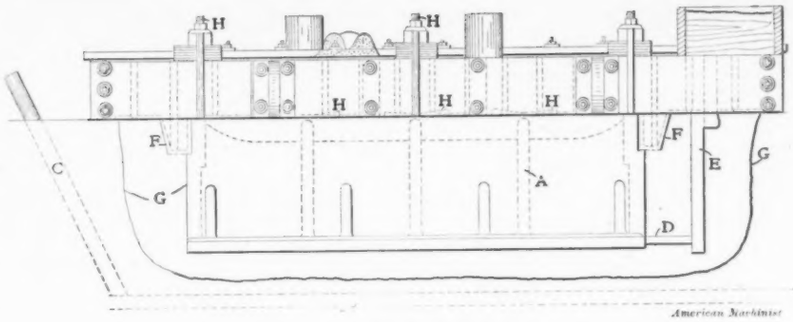


FIG. 4. SIDE VIEW OF THE MOLD.

chucks and rams it up as he would a part of any flask. It will be seen that the plate *B*, Fig. 3, has fingers *F* cast on it which extend over the side pieces *G* of the pattern between the braces *H* of the pattern, against and between which gaggers are set. When the sand is rammed up part way between the chucks on board *I*, Fig. 3, a good venting is given the mold, cinder

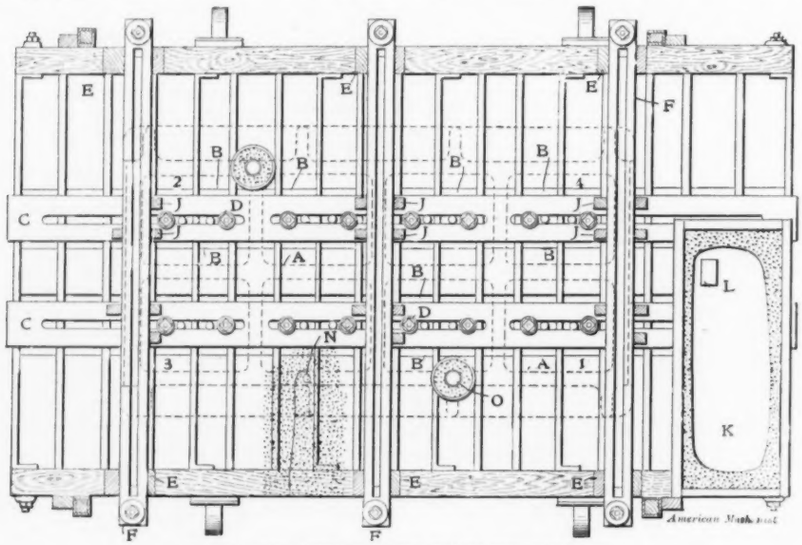


FIG. 5. TOP VIEW OF MOLD READY FOR POURING.

E, and a parting made, following the line *F* at both ends of the pattern.

I have endeavored by line *C* to cut away the sand from the side of the pattern, and show it in the floor of the foundry. The parting is now made on each side of the bank of sand rammed in at the ends, oily paper is laid against these sides, and held by nails. A parting is also made at *B*, Fig. 3, and a plate to carry the side to be lifted out—as *C*, Fig. 3—is rapped down to a bearing, and parting sand dusted around it.

Let me call attention to this plate. Besides the wrought-iron staples for lifting the plate *D*, Fig. 3, rods *E* are cast into the plate. A board having chucks on it is bolted to these rods. When lifting out pockets of any depth with a plate anyone accustomed to this kind of work knows how much rodding is required to strengthen these masses of sand and keep them on a lifting plate; while in the way I have shown the sand is easily held in place as the molder claywashes the board, and pockets are formed, covered with paper, the sand is rammed up to the joint which is made, and the cope is rapped down and staked.

When the cope is barred, two rows of chucks are arranged so that they come over the two rows of cores which are to form the inside of the casting a few inches from the outer edge of these cores, and when the cope is rammed up the space over where the center of these two rows of cores is to come—between the two rows of chucks—is not rammed up, but left open—see chucks *B*, Fig. 5. The cope is hoisted off and swung to one side, and finished. The main pattern is drawn, and the side pieces of the pattern forming *O*, Fig. 3, are drawn inward together with the brackets *C*, which are fastened to it—see *A*, Fig. 2, with *C* attached.

Had these sides broken down when the pattern was drawn inward, the sides could easily have been hoisted out; as it was, the pieces had enough draft, so that they came out leaving the mold perfect..

The molder rounded all the corners, thus saving fillet work. Pieces of plank 3 inches thick were laid on the bottom of the mold as at *A*, Fig. 7, and the cores were arranged on them to form the inside of the casting as at *B*, Fig. 7. In setting the first core a piece of board the thickness of the side, and the end were used as gages, and the core set against them, starting with a corner core.

The cope was then lowered on, and hookbolts *P*, Fig. 3, passed down between the chucks of the cope—see *B*, Fig. 5—and hooked into the staples *J*, cast into coreirons, or grids, seen at Fig. 3—*K* showing the grids and *L* the manner of rodding to support the sand composing the core, and *M* the cinder pocket, which has an opening extending to the top of the core to bring off the vent.

Wedges are forced between the bars and

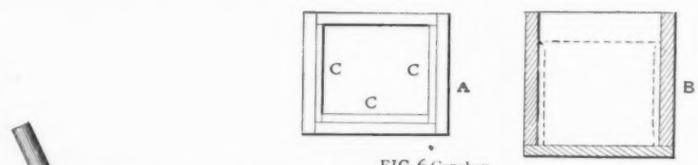


FIG. 6 Corebox

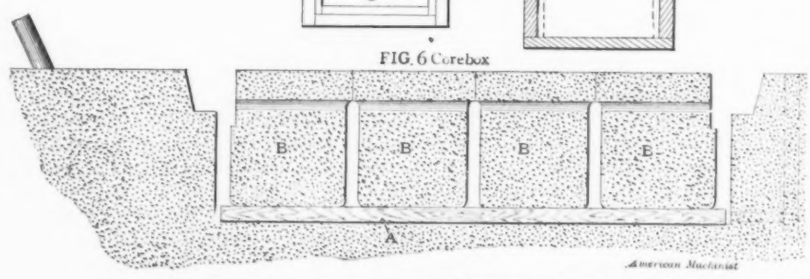


FIG. 7. CORES RESTING ON PLANKS THE THICKNESS OF THE CASTING.

chucks of the cope and the cores—see *H*, Fig. 4—gatesticks are to bring the vent from the cores to the top of the cope, and the sand is rammed in between the chucks, around gatestick and hooks—see *P*, Fig. 3. Gatesticks are removed, pieces of wood about ⅝ inch thick, and bars are laid on the ends of the flask where wanted, and bars of iron having long slots in them—see *C*, Fig. 5—are laid on them, bolts *P*, Fig. 3, being guided up through the slot holes as they are placed; washers are placed on the bolts large enough to have a bearing on these bars or binders, as *D*, Fig. 5; nuts run down, and tightened.

The cope is then lifted off with the cores hanging to it, and pieces of plank *A*, Fig. 7, removed. The drag ("hole in the floor," as one man called it) is given a coating of silver lead—it doesn't matter whose, all facing dealers have the best—and cope replaced.

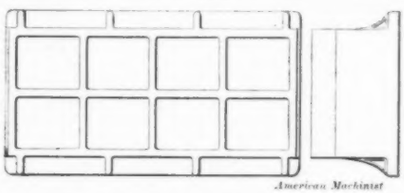


FIG. 8. TOP AND END VIEW OF CASTING.

Blocks *E*, Fig. 5, are placed on the edges of the flask, binders *F* laid on them, crossing binders *C* and raised above them a little—better seen, perhaps, at Fig. 4. The hook-bolts are tightened by nuts *H*, then the wedges are lightly driven between the binders, as *J*, Fig. 5. In this way all upward strain is taken by binders across the cope.

Fig. 5, runner *K*, gate *L*, flow-off *N*, risers *O* for churning, weigh 9,450 pounds.

It will be seen the pattern can be easily taken apart if only nailed together, and the lumber used again; and, with all respect to the patternmaker who can and does do good work, it does not require an extremely high-priced man to make the pattern.

Electrification of Ore-Carrying Road.

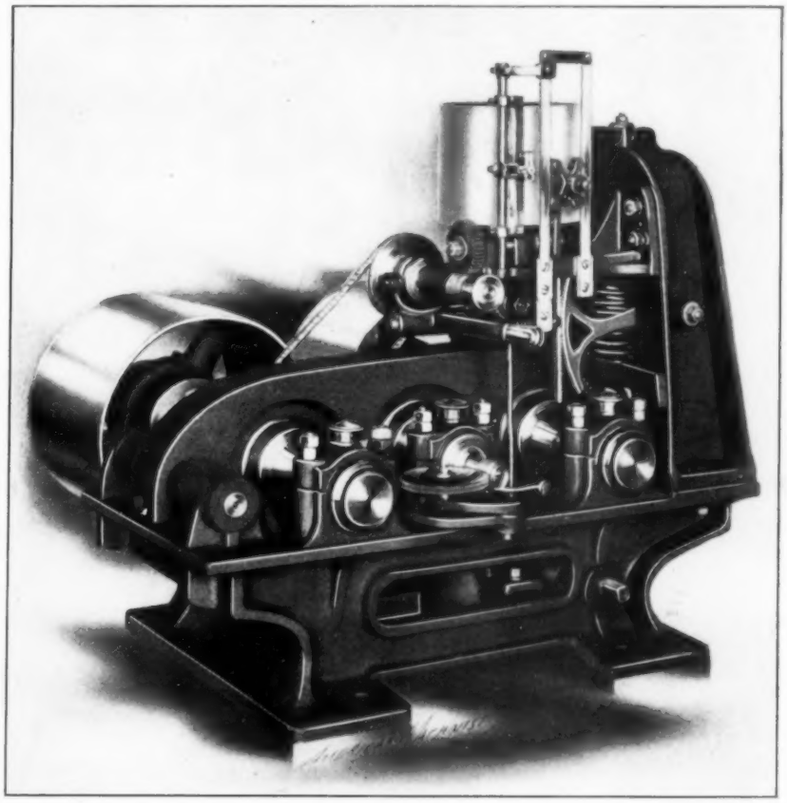
The Duluth, Missabe & Northern Railway will, it is said, discard steam as the motive power on its road as soon as possible, and electric locomotives will be used instead. The third-rail system is contemplated. The plans are also said to include the use of electrical aparatus for unloading the big steel ore cars at the docks. The road is 72 miles long, connecting Duluth and Mount Iron, Minn., through Iron Junction and Wolf, with 37 miles of branches.

The waters of Lake Titicaca, the largest body of water in Peru, and the highest navigable lake in the world, are to be utilized for electric power development in connection with various enterprises in its vicinity, and for long distance transmission.

A New Swiss Dynamometer.

BY EMILE GUARINI.

Messrs. Joh. Jacob Rieter & Co., of Winterthur, Switzerland, have recently built a new type of their geared dynamometer, having a capacity of about 12 horse-power. The gearing has only about 500 millimeters development and the work measured by the pressure on the teeth, the number of revolutions and the duration of the test, is expressed in demi-kilogram meters in such a way that it is necessary to divide the result by two in order to obtain the work in kilogram-meters, or by 150 in order to obtain it in horse-power. The frictional work absorbs about 2½ per cent. of the power transmitted.



A SWISS DYNAMOMETER.

A gray-iron frame supports two shafts upon which gearing and pulleys are keyed. One of the pulleys receives the power of the principal transmission, and the other transmits it to a countershaft or to the machine to be tested. Between the pulley shafts there is an intermediate gear, which is supported by a lever adapted to swing around a pin at one end, while the opposite end is connected to a suspension spring. The apparatus being placed between the transmission or shafting and the engine which is being tested, the pressure of the teeth upon the intermediate wheel causes this latter to descend and with it the movable lever, at the same time flexing the spring in proportion to the power to be balanced. Each movement of the lever is conveyed by a system of levers and a stylus to a strip of paper, whereon it traces a curve, the ordinates of which are in proportion to the forces transmitted. By means of a specially graduated scale there may be deduced from the curve obtained the power in kilogram-meters. The registering apparatus is driven by one of the shafts and is thrown out of gear by means of a handle, the same movement disengaging the counter which marks the number of revolutions of the intermediate wheel. A certain number of interchangeable wheels for the registering apparatus, also graduated scales and springs of different resistances, permit of the application of extremely varied powers and resistances. The loss of effect is to be deducted from the gross work in order to get the effective work.

At the commencement of the test the fixed point must correspond to the zero on the scale, and the regulation is effected by suitably flexing the spring, while the dynamometer runs light; the weight of the intermediate wheel and of the levers does not exert any influence upon the results.

The counter is composed of two superposed screw wheels and one common endless screw. The upper wheel has 100 teeth: it is divided into 100 equal parts and an index marks the revolutions of the intermediate wheel from 1 to 100. The lower wheel has 101 teeth, and each of its divisions corresponds to 100 revolutions

of the intermediate wheel, so that one revolution expresses 10,100 revolutions of the intermediate wheel of the dynamometer.

Two eccentric levers flex the spring when the dynamometer is running light. When abrupt and considerable variations occur in the power being measured, the apparatus tends to race, and the pressure upon the teeth becomes negative; the intensity of which can be read upon the graduated scale below the zero. In this case the work thus restored is to be deducted from the gross work shown.

Slight and frequently repeated oscillations greatly hamper the reading of the diagram; and, in order to obviate this drawback, the dynamometer is fitted with an oil cylinder, which can be regulated.

The strip of paper for the registering device has a width of from 230 to 240 millimeters and a length of 10 to 11 meters. The rate of speed at which it unwinds is controlled by a system of endless screw wheels. When the oscillations are considerable and at fairly long intervals, the mean height is determined by means of the Amsler polar planimeter. When the running is sufficiently regular only slight oscillations are produced. The mean height is then determined by a line which equally divides the sinuosities. If the work is intermittent, account is only taken of the entire period, without considering the fractions. In cases where the engine is connected with the dynamometer by intermediate shafts, the indirect resistances must be taken into consideration; if the shafting runs irregularly, the results are brought back to the normal speed in order that the experiment may be conclusive. The motive power being transmitted to one of the toothed wheels, the other must drive the machine to be experimented with either directly or indirectly.

Milan International Exposition, 1906.

Professor J. H. Gore, of George Washington University, Washington, D. C., and L. S. Ware, of Paris, are commissioners for this exposition. In a circular letter they say: In order to appropriately celebrate the completion of the Simplon tunnel—one of the greatest known triumphs of engineering—an international exposition, under royal patronage, will be held in Milan from May to November, 1906. It will be the largest European exposition ever held outside of Paris. Practically all of the European countries will participate officially, as well as several of the Asiatic nations. In the transportation section, retrospective exhibits will show the historical development of the various methods of travel. The dominant feature will be motion. All products, as far as possible, must be shown in connection with the processes, thus filling the halls with live exhibits. Arrangements will be made for field tests and competitive trials in all classes where it is expedient.—*Ry. & Eng. Review.*

Simple Steam Turbine Engines—II.*

BY JOHN RICHARDS.

It is not unusual, in papers of this kind, to introduce the subject of constructing and operating machines, and it might be out of place in papers relating to some kinds of machines employed in the arts; but, as before pointed out, information on this subject is, at this time, the lacking element in steam-turbine practice.

At the risk of prolixity I will summarize and restate in a compendious way the points already gone over, and then proceed to constructive features.

All fluid machines belong to two classes:

First, machines that receive and translate the force of fluids or motive engines of all kinds. Second, machines to impel fluids, including pumps of all kinds. This is a division easily understood. Fluids include air, steam, water, gas, all of which come under and are amenable to certain ascertained laws, and are divided into elastic and inelastic fluids.

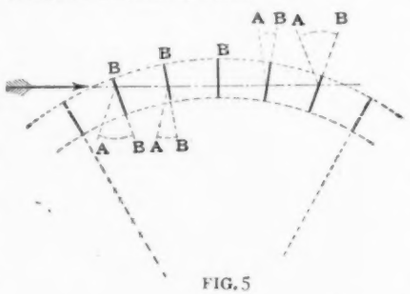


FIG. 5

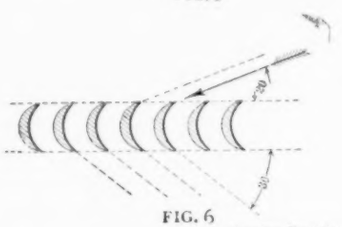


FIG. 6

American Machinist

EFFECT OF NUMEROUS VANES.

Fluid motive engines are divisible into two classes—positive and free running. The positive class includes all that operate with pistons and which measure, positively and in proportion to movement, the amount of fluid that passes through them. There is no time factor in positive-acting machines; hence the rate of movement and the work done in a given time are under control. Within certain limits a positive-acting machine may run fast or slow, and its speed can be varied at will. The latter is the most important advantage that positive or piston machines have over the impulsive or non-positive type, and lends itself to a wide field of uses.

This advantage of a variable rate of movement is, however, diminishing all the time, because of the improvement in transmission gearing, designed to change the relative rate of movement.

*Read before the Technical Society of the Pacific Coast.

The free-running class of fluid machines, those which operate by impulse and reaction, have a "time function" to deal with, and their speed is a determinate quantity, based upon the flowing velocity of the impelling or impelled fluid. This class embraces water wheels of all kinds—gravity, impulsive and reacting; also steam turbines.

The velocity of this impulse class of machines is inversely proportional to the density or weight of the fluids that impel them. A centrifugal pump and a rotary fan seem very different machines, but they operate according to the same law, and their speeds are inversely proportional to the weights of the fluids, or as 800 to 1. This indicates the great velocity at which single-action steam turbines must move, practically about 90,000 feet a minute.

Such a velocity produces various phenomena, such as the disturbance and stretching of the rotative parts by centrifugal strain; tendency to vibrate; noise, the heating and wear of journal bearings and other things. The centrifugal strain can be imagined when we reflect that 1 pound of metal, on the periphery of a wheel 2 feet in diameter, will, at a speed of 10,000 revolutions per minute, represent a centrifugal force of 34,000 pounds, or 17 tons.

Referring now to the constructive features of steam turbines, the first thing considered will be the buckets, and at the beginning I will claim that these are at fault in modern practice because of being curved in one plane only; consequently they have but one correct position in the jet throughout the whole arc of their movement and in nearly all cases are cut out of solid metal, and have angular or imperfect corners.

This form of buckets is due no doubt to the difficulty of machining their surfaces except in straight lines, but it produces, in turbine wheels, several features of construction that are far-reaching in effect, also far from apparent until carefully examined.

First. It increases the weight and number of buckets about fivefold in the attempt to secure impingement of the steam jets normal to the straight faces of the buckets.

Second. It distorts the course of reaction from a possible angle of 15 degrees to an angle of 20 to 30 degrees required to secure clearance.

Third. It makes necessary a side application of the jet, introducing lateral stress on the wheels and inducing vibration.

Fourth. It augments, in proportion to the added number of buckets, the amount of fluid friction.

Not to include the resistance of corners.

Fifth. The disposition of material in solid disks prevents the employment of its fibrous or laminated nature in the direc-

tion of strain and demands very expensive homogeneous material, a result indirectly of the numerous buckets.

This is a bold arraignment of certain

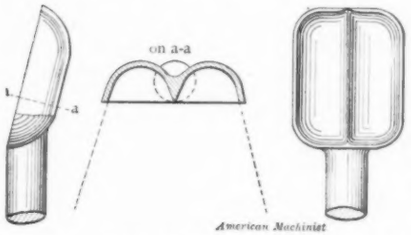


FIG. 9. FORM OF BUCKET ADAPTED TO A REDUCED NUMBER.

constructive features, and would require great temerity on my part to bring forward were I not fortified by something stronger than inference and personal experience in this matter. I allude to the tangential water-wheel practice on this Coast, which has passed through a crucial course of development that furnishes copious suggestion for single-action steam turbines.

The number of buckets is a very important matter. It is a sequence of the angle of impingement, and this again is a sequence of the bucket's shape, as will be shown further on. The surface or fluid friction, which offers a considerable resistance and loss, is in proportion to the number of buckets employed, and should be considered in this connection.

Most of the steam-turbine buckets now made have angular corners, and, when there are not such corners, the end walls of the buckets are so distant from the jet as to lose reactive effect in that direction. We long ago learned to keep water out of sharp corners in buckets.

In respect to the number of buckets or vanes, Fig. 5 shows how the line of impingement varies in respect to the straight faces of radial buckets, being as the sine of the angles *A* and *B;* and there is no way of securing impingement even approximately normal to the straight faces except by employing a large number of buckets set close together. The result is much the same whether the jets be applied on the side or tangentially, as shown in Fig. 6, where the angle of entrance is 20 degrees and that of discharge 36 degrees.

The trend of practice in tangential water wheels has been to wider spaces between the buckets, better angles for discharge and recently to uniformly curved buckets, as hereinafter explained.

This feature of oblique impingement is accountable for at least three-fourths of the buckets now employed, and the result is loss by increased surface friction and distortion of the angle of reaction.

Fig. 6 shows approximately the entrance and discharge angles in the De Laval engines, embracing an arc of 56 degrees, which, by reducing the number of buckets, could be reduced to 36 degrees or less if the problem of oblique impingement were out of the way. Fig. 7 shows spacing for tangential buckets to secure an easy discharge at 20 degrees.

In the Riedler turbines, the angle of discharge is 180 degrees. In other words, the discharge is opposite the jet, but this calls for increased surface, more width and weight for the revolving member, and expensive work in construction, which are hardly offset by countervailing advantages, and which certainly prevent a cheap and general manufacture of the machines. It would not be becoming in myself to criticize the computations and designs of Professor Riedler, but I am looking at the practical and mechanical phases of the problem, and seeking means whereby such engines may be made at a reasonable cost by common facilities and operate at reasonable efficiency.

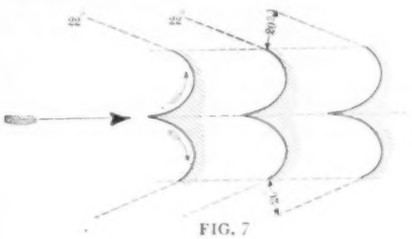


FIG. 7

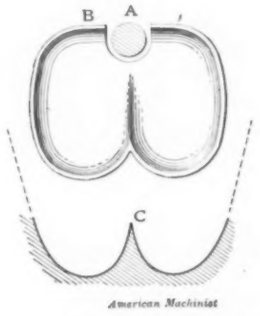


FIG. 8. BUCKETS CURVED IN ALL PLANES.

The contention is that the buckets of steam turbines should be curved in all planes approximately as shown in Fig. 8, taken from a form of water buckets of a very advanced type by W. A. Doble, of this city. These are of double concave or cup form, in order to permit direct and balanced impingement at the various angles in which they are presented to the jet, and have a central dividing wedge to permit tangential application. This latter is not presented as a new idea, being simply the final form and method for tangential water wheels on this coast, after more than 25 years of continuous experiment and the attainment of an efficiency that is, if not final, so nearly so that a very narrow margin of avoidable losses remains.

If there exists any reason why this same system or method of operating is not applicable to buckets for steam, I am not able to perceive it. Of course, expansion of the steam and divergence of the jets would call for modification not determinable until a form of nozzle and the contour of the jet are assumed.

Not knowing how far the contour of a jet of steam will permit its passage through notch *A*, in Fig. 8, I am not able to say how far this feature is applicable to an elastic fluid, or how far such a passage as that at *A* would become a spillway when a jet was impinging at the opposite end of the bucket. I will not discuss this here, further than to point out that this passage *A* avoids passing the rim *B* of the bucket through the jet and the disturbance that must result from this cause.

The dividing wedge *C* permits tangential application of the fluid and produces a shallow and balanced discharge. As a feature of impulse-fluid motors, it has not met with analysis and adoption except on this coast and in the Riedler steam turbines. Its function, or rather its effect, is not always understood. The avoidance of side stress on wheels, especially on steam turbines at their enormous speed, is important, and so is the dual discharge which permits a more nearly uniform velocity throughout the discharged water section, because the latter is shallower. After many years of practical experiment, as well as some spent in scientific work, the dividing wedge was confirmed at the University of California in 1883* as a permanent feature of good practice for water.

In Fig. 9 is shown a form for buckets capable of receiving and properly reversing a jet of steam coming within angles *A* and *B*, and permitting the number of buckets to be reduced to what will come within and cover the divergence or expansion of the steam jet, or about 1 bucket for each 8 degrees of arc for wheels from 20 to 40 inches diameter. This is less than one-fifth the number now employed for wheels having buckets straight in one plane, as in Fig. 6.

Such buckets can be stamped out of fine steel and made strong, smooth and integral with their radial supporting stems. They can be made of uniform thickness, with no more metal than their operative

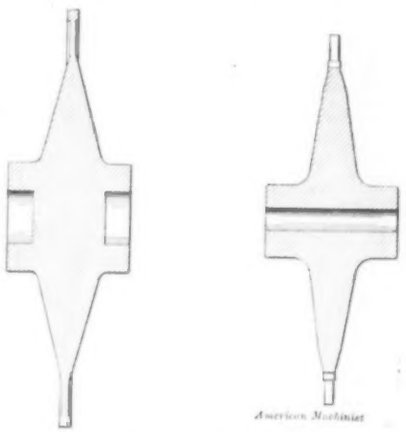


FIG. 10. SECTION OF WHEEL.

functions require, and of less than half the weight of those cut from solid metal, so that, compared with the usual form of

*Partial Turbines or Tangential Water Wheels. College of Mechanics, Berkeley, Cal. By Ross E. Browne.

steam turbines, there would be one-fifth the number and (excluding the fastenings) less than one-half the weight, so that the mass in the rim of a turbine wheel with this form of buckets can be reduced to one-eighth or even one-tenth of that in common practice.

In the construction to be hereafter suggested, the buckets represent and constitute the whole rim of a wheel.

As to wheels or disks, nearly all now in use for single-action engines are solid disks, as shown in Fig. 10, a matter much to be wondered at if we consider the strains. Not everyone has had the opportunity of seeing disks at high revolution, circular saws, for example, which, at a speed of 10,000 feet per minute, assume a sinuous path at their peripheries and lose their stability by stretching.

A bucket, weighing an ounce, and revolving in a circle 24 inches in diameter at the rate of 10,000 revolutions per minute, will exert a centrifugal strain of 1 ton, and its supporting sector and fastenings will exert 50 per cent. more—a result scarcely conceivable. The disposition of mass, strains and section may mathematically produce a body of the spindle form shown in Fig. 10 and in all diagrams that have been worked out by computation, but I do not believe that practical experiment will evolve anything of this kind.

Assuming this centrifugal force applied to a sector of a solid disk of uniform section, a circular-saw plate, for example, the error of such construction becomes apparent. The disposition of the material, in a sector of the wheel of which the bucket is the outer end, will be inverted, so to speak, and disposed inversely as the strain. The perimeter has no function requiring a continuous mass there, unless it be to hold a series of buckets set close together or to provide mechanical fastenings for them.

To compensate this contradictory disposition of material, the wheels are commonly made in lenticular form, as shown in Fig. 10, so that the mass of a sector is approximately a radial body of nearly equal section, apparently providing for centrifugal strain if change by elongation is ignored; but this latter is the principal fact of all, and one which cannot be provided for in a solid disk of any form, because the conditions are not ascertainable. I have made diagrams to show the mass, in 10 degrees of arc, for several forms of wheels, but want of space prevents their reproduction here.

I have had made, by a very competent engineer, an analysis of the strains in several forms of solid disks, independent of elasticity and of change by stretching, a condition that defies computation in metal forms of the kind. It is an interesting and also an intricate problem, but I believe of but little practical value.

A very extensive analysis of such disks or wheels, made by Frank Foster, was published in *The Engineer*, London, No. 2506, January 8 of the present year. It is a study in mathematics of a very abstruse and no doubt interesting nature to students in calculus, but the weight and cost of such disks, if there were no other reasons, preclude their use for plain simple engines, such as those to which these remarks are directed. Professor Riedler seems to disregard such theories respecting the disposition of material in his disks.

I have shown how four-fifths or more of the weight in the periphery or rim of such wheels can be dispensed with, and I will suggest for the body of the wheels a construction which will eliminate inherent strains due to elongation or stretching, and at the same time dispense with the greater part of the mass and reduce the centrifugal strain accordingly.

In wheels moving at such high velocity, certainly the first thing should be to remove from the disruptive zone all joints and mechanical fastenings. These must necessarily include an extra mass of inert material at the points of juncture, plus bolts, rivets or other means of attachment. Buckets or other parts fastened by dovetail joints are open to the same objection, because extra substance must be added to endure compression and holding strain.

The construction shown in Figs. 11 and 12 is suggested, the buckets being made independent, avoiding circumferential strain and permitting free elongation by centrifugal stress. The spokes *B* are tapered, so that their sections will stand the centrifugal strain within the mass lying outside of any point. They are fastened in a nave by welding or by suitable mechanical means, the strength of which will equal their section.

The nave of the form shown in the diagram will not expand and become loose on a spindle with the amount of weight in a wheel constructed as shown.

In respect to gearing for transmission, I believe that the principal impediment is a want of confidence. Nowhere in the arts have we been called upon for translation at such high velocity; consequently we are not prepared to provide devices such as are required to reduce the speed of single-action steam turbines, where the elements of transmission have to move from 4,000 to 6,000 feet per minute. I know of no reason why plain tooth wheels, or tangent gearing, will not run at this speed, and I confidently expect that they will do so without any objectionable result.

Respecting tooth gearing there is much apprehension, which arises from the difficlties of constructing it in perfect form. In the Continental Hotel in Philadelphia a screw elevator was in use for more than twenty years. A bevel wheel of 5 feet diameter and a pinion of 10 inches diameter drove the screw, and they were absolutely noiseless. They were made at the Industrial Works in that city, where I was working at that time.

In an experiment made many years ago, at the works of William Sellers & Co., to test the ultimate speed of transmitting apparatus, bands of one kind or another were employed up to a point of failure, then plain spur wheels were resorted to, and, as I have been informed, they were entirely successful to the point of disrupting a steel disk driven by the gearing. Of course, such gearing to run without noise must be perfectly made; and, if there is

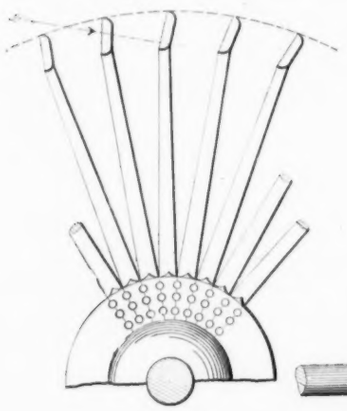


FIG. 11.

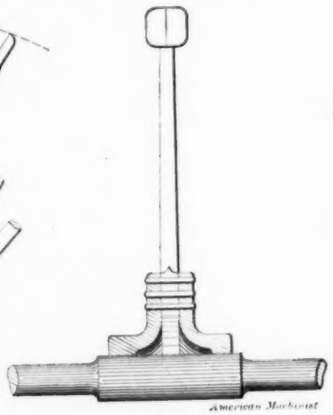


FIG. 12.

TURBINES WITH REDUCED NUMBER OF BUCKETS.

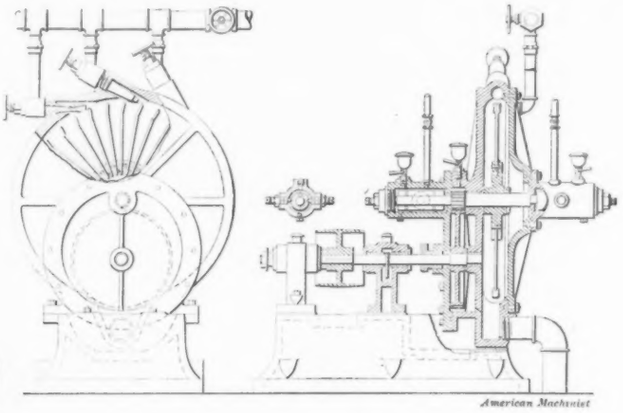


FIG. 13. THE COMPLETE MACHINE.

reason why they will not transmit at 4,000 to 6,000 feet per minute, I fail to conceive it, especially when inclosed in the turbine wheel chamber, as hereafter suggested.

Twenty-five years ago I constructed machines in which bands of flax webbing ran at 6,000 feet per minute without difficulty.

These bands drove spindles at 12,000 feet per minute, and the machines are yet in use in Columbus, Ohio, where they were made in what might be called a country shop.

For a good many years I was engaged in designing and making machines in which the spindle bearings had a velocity of from 2,000 to 3,000 feet per minute, were subject to lateral strain and mounted in weak framing, and they ran cool when the fit and alinement were good. Consequently I am in no way alarmed at the requirements in steam-turbine practice, and I confidently expect to see power transmitted by bearings moving at a surface velocity of 5,000 feet per minute and spindles run cool at 10,000 to 15,000 revolutions per minute.

In my opinion, the gearing of transmission should be inclosed with the motor wheel, and should operate in the vapor contained in the casing, that being open to a condenser. There are three reasons for this: (1) The better performance and wear of wheels when steam lubricated; (2) the absorption of noise, if that be present; and (3) the avoidance of packing glands on the spindle of the motor wheel, a very objectionable feature, present, I believe, in all the steam turbines now made.

Such packing glands are objectionable not only because of a possible resistance and loss of power by friction, as pointed out by Professor Sweet, but because they permit the entrance of air into the condenser and involve the wear and care of packing.

The interior of the wheel casing should be annular, turned smooth and otherwise so arranged as to permit the free revolution of any vapor it may contain. It has been suggested that a sector or spoke construction of the wheels would cause serious resistance by windage or fanning the steam or vapor in the casing; but the attenuated vapor in a casing, 10 to 12 pounds below the atmosphere, would not offer much resistance if fixed, and perhaps none to consider at all, if free to revolve with the wheel.

In respect to bearings for the wheel spindle, these should be parallel, hardened and ground, mounted in pivoted split shells of gray iron, and, like the reducing gearing, inclosed in and exposed to the vapor of the wheel chamber. This may seem objectionable because of heat, and it would be so in machines as now arranged, with the casing exposed to a high temperature.

This latter I believe to be a mistake. No avoidable heat should be communicated to the casing to raise its temperature above that of the expanded steam. A low temperature would not cause appreciable thermal loss in the jet, but would assist a condenser and conduce to other desirable objects that have been named.

In respect to nozzles for buckets, such as have been suggested, it is a difficult subject without experiment and when the contour of a jet at different pressures is not known. I am of the opinion, however, that if inclosed the tube should conform to the natural contour of the jet. With side application of the steam on buckets flat or straight in one plane, there is no doubt a gain results from the use of a diverging nozzle, but in buckets in which the jet is divided the case is different.

On the whole, I think it safe to assume that the form of nozzles for steam turbines of the single-acting type is not a problem that will much interfere with their successful construction. That there should be a converging anterior chamber, a throat to determine volume and a diverging nozzle is obvious, but further than this the result is no doubt a refinement that has more importance in a mathematical theorem than in the workshop.

Some years ago, I think in 1901, I asked Mr. Brown, whom I have several times quoted, his opinion respecting steam-motor nozzles. He replied as follows:

"As regards the De Laval nozzles, the learned here are of various opinions as to their value. Professor Meyer, in Zurich, who has experimented long with the De Laval, says that it is in no way superior to a common nozzle."

The views and suggestions which I have had the privilege of advancing here have been imperfectly embodied in an organized mechanism, shown in Fig. 13. This drawing was made about two years ago, and it would be modified in various ways if reproduced now. It, however, embodies most of the features that have been suggested.

I presume this presentation of a subject, without the scientific furtherance common at this day, can hardly be considered a conventional contribution to the art. It may not be so accepted, but I venture the prediction that the evolution of cheap steam turbines, adapted for general manufacture and use, will before long result from effort and experiment on the part of intelligent and experienced mechanics aided by scientific data.

This assumption has some answer in the fact that, already mentioned, seventy-five years ago Mr. Avery, a country millwright in western New York, made successful reaction steam turbines, and applied a large number of them successfully to common rough uses. He also made impelling members which contained about one-tenth of the material now employed, and, as I believe, in a more practical manner than in many wheels now being produced. The work was done in blacksmith shops, at a time when accurate tools and processes were almost unknown, and I am much inclined to agree with the opinions of Prof. John E. Sweet, whose skill and judgment no one is likely to question, who, in a recent letter to the author, said: "If I were to engage in the manufacture of steam turbines I would begin with the Avery one."

The steam-turbine practice of our day is the finest example of constructive engineering work that the world has ever seen. It is confined to large units, not because of operative impediments in small engines, but because these cannot be furnished separately at such prices as can be obtained.

From these premises I conclude that future steam turbines for common use will be single-acting and condensing whenever possible, with wheels of sector construction as light as can be made. There will be no packing glands on the main spindles, and the first movers for transmission will be plain spur or tangent gearing.

I will conclude this paper with brief mention of the economic results that have been reached with steam turbines, as illustrated by the generating engines recently constructed in Switzerland, one with very high-class piston engines and one with turbines, each of 5,000 horse-power. The results were as follows:

Weight of piston engines and generators, 598 tons. That of the turbines and generator only 78 tons, or nearly 8 to 1. The steam consumption by the piston engines was 11 pounds per indicated horse-power, and for the turbines 1 kilowatt with 14 pounds of steam, or about 10 pounds per horse-power. Oil consumption was as 20 to 1 in favor of the turbine, and attendance about 5 to 1.

The piston engines were made by Sulzer Bros., of Winterthur, and the turbines by Brown, Bouverie & Co., of Baden, in Switzerland. The quantities were furnished to me by Mr. Brown, of Basel, Switzerland, with whom I had personally discussed the subject some time before the tests were made and who had forecast the result with much accuracy.

Cement for Iron.

Sulphur flowers, 6 parts; white lead, dry, 6 parts; powdered borax, 1 part. Mix well by sifting and keep as a dry powder in well-closed tin box.

To prepare this for use, make a thin paste with strong sulphuric acid; press this together at once. It will become hard in five days.

That some machinery building concerns at least are doing a profitable business, is shown by the recently published report of the year's business of the Mergenthaler Linotype Company, according to which its gross receipts for the year ended September 30 were $3,749,678, of which $2,204,520, or something like 59 per cent. of the gross receipts, were net profit.

Six-Spindle Special Driller.

This machine was built for drilling the spanner holes in small hardware and machine parts all at one operation. The half-tone illustration, Fig. 1, shows the machine complete; the line drawings, Figs. 2 to 6, show different details referred to later. The general scheme is to have the work clamped in the center, while the six spindles, which are equally spaced around it, are fed in simultaneously, the machine being light acting, capable of very rapid action, and suitable to operation by boys. It will drill holes from the smallest up to ¼ inch.

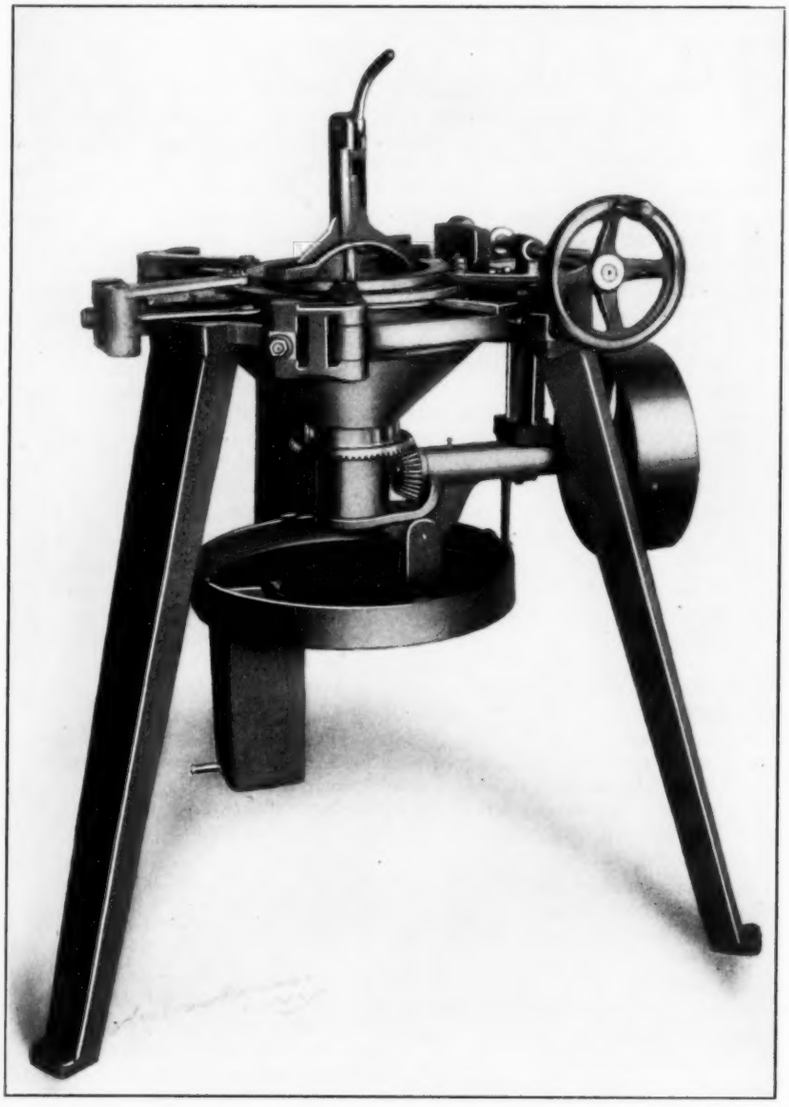


FIG. 1. SIX-SPINDLE SPECIAL DRILLER.

The construction of the machine is as follows: The three legs support the plate or spindle-disk, Fig. 2, which forms the main bed of the machine. From this disk in the center is suspended a bowl-shaped casting, Fig. 3, and *A*, Fig. 4, which catches the chips, and oil when the latter is used, and which has a central hub upon which the jig for holding the work may be supported. This bowl has a hollow extension downward, the outer surface of which forms a bearing for the hub on the lower end of the large bevel gear, Fig. 5, shown in place on its bearing post at *B*, Fig. 4.

Upon the upper surface of the bed-plate rests a ring which rotates through an angle of approximately 18 degrees. To this ring are connected the long arms of the six bell-cranks, one of which is shown in Fig. 6; the short arms of these bell-cranks are connected through ball thrust bearings to the outer ends of the six drill spindles. The ring is provided on a portion of its surface with a segmental worm wheel, which is driven by a worm on the shaft of the hand-wheel seen in the upper right-hand corner of the photograph. By means of this hand-wheel and the intervening parts the six spindles may be simultaneously fed in toward the center, and withdrawn again, the travel being 1 inch. It will be noticed that the short

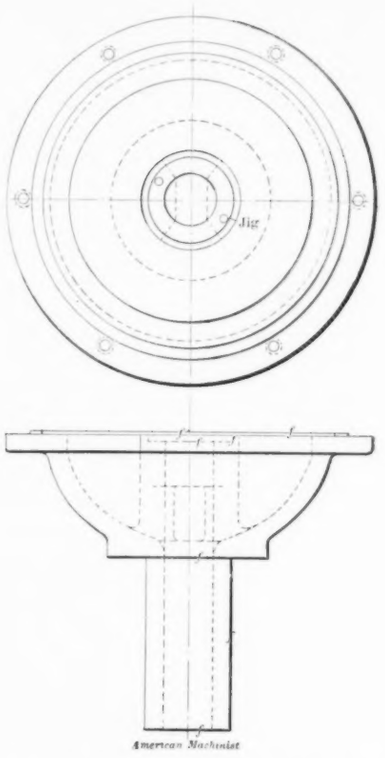


FIG. 3. BEARING POST FOR MAIN BEVEL GEAR. SIX-SPINDLE SPECIAL DRILLER.

end of the bell-crank is a double crank, but the whole bell-crank is cast in one piece.

The drive of the spindles is as follows: The main driving shaft carries a pulley 14 inches in diameter and 4 inches face, and runs at 140 revolutions per minute. The large bevel gear with the conical body or web, shown in Fig. 5, carries on the hub at the bottom of it a 64-tooth bevel gear, which is driven by a 32-tooth bevel pinion on the end of the main driving shaft. The conical bodied gear has 180 teeth and drives 18-tooth bevel pinions on

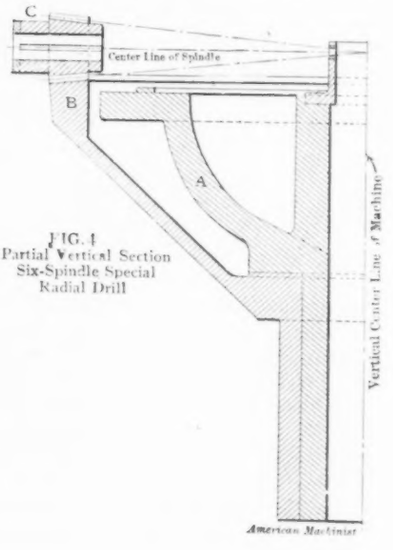


FIG. 4. Partial Vertical Section Six-Spindle Special Radial Drill

the drill spindles, the spindles sliding through the pinions during the feed motion. One of these pinions is shown at *C*, Fig. 4, in mesh with the main gear *B*; the openings through the spindle disk marked *C* in Fig. 2 are occupied by the pinions. When the driving pulley is running 140 revolutions per minute the drill spindle will run 700 revolutions per minute.

The upward projecting hub of the central fixed bowl, Fig. 3, has two openings near the bottom of the bowl, which permit the oil and chips to escape and drop down through the hollow center into the chip pan seen in the photograph; from this the oil runs through a sieve into the oil reservoir. The chips therefore cannot come into contact with the gearing or running

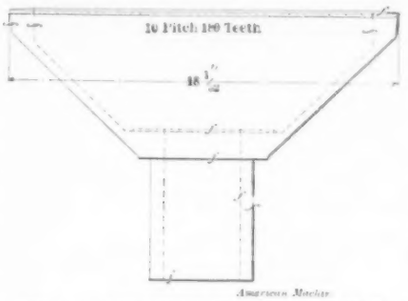


FIG. 5. MAIN BEVEL GEAR. SIX-SPINDLE SPECIAL DRILLER.

ings for the spindles are inserted into the seats *E*, Fig. 2.

The weight of the machine is 1,025 pounds. It is made by the Garvin Machine Company, New York.

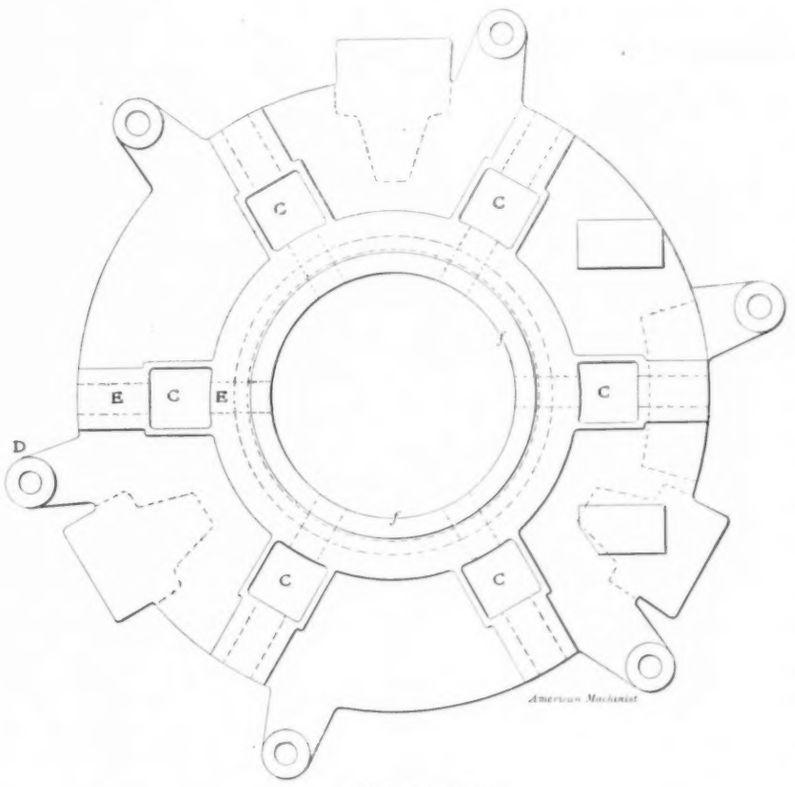


FIG. 2. Spindle Disc
Six-Spindle Special Radial Drill

parts of the machine. Upon the upper end of the central hub of the casting, Fig. 3, is mounted a jig for the work.

The bracket which forms the bearing for the main driving shaft is, as clearly shown in Fig. 1, supported partly by a projection downward from the spindle disk, Fig. 2. The inner end of the bracket is attached by screws to the lower end of the fixed bearing-post, Fig. 3.

Fig. 2 shows the bed-plate of spindle disk by itself. The projecting arms and bosses *D* form the fulcrums for the spindle levers, Fig. 6. The bronze bear-

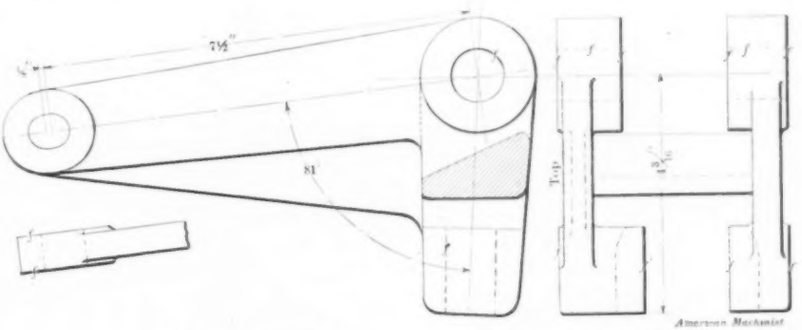


FIG. 6. SPINDLE LEVER. SIX-SPINDLE SPECIAL DRILLER.

Pipe Flange Standards.

We have received a reprint—from the *Journal* of the American Society of Naval Engineers, Vol. XVII, No. 3—of a paper read before the society by Luther D. Lovekin, chief engineer of the New York Shipbuilding Company, Camden, N. J., entitled "Suggestions as to the Adaptability of a Universal Standard Flange List for Marine Work."

The pamphlet is full of interest from cover to cover. While leading up to his invention of a new pipe joint, the author says:

"Too often does it occur in the drawing rooms of large establishments that when a flange list is to be made out it is given to some young draftsman of very limited experience, with a view, no doubt, to economizing; and when finished we find this new list embodies the mistakes of the past, as well as some new features which are liable to add to the already innumerable troubles existing in this line."

At another place the author states:

"It seems to me there has been more talk on such items as *multiples of four bolts being absolutely essential to any standard*, and the thoughts as to how this or that suggestion would affect the valve-maker, with his *numerous patterns* on hand, than as to how this whole matter was going to affect the engineer, whether at sea or on shore, as well as the owners of our large vessels and industrial works. . . . "Furthermore, in my opinion, any standard flange list should have the joints or flanges *equal at least to the bursting strength of the pipe itself*, so that we could rest assured that in the case of water hammer and other shocks of a similar nature we had at least done our best from an engineering standpoint."

Then follows a full list of flanges, from 2 inches to 20 inches diameter, designed for 300 pounds pressure.

There are several plates, comparing the Lovekin flange for 300 pounds pressure and under with flanges used for similar pressure, both in the United States Navy and in the merchant marine; a list, comparing the weights of the proposed "Lovekin universal" with those of the United States Navy Bureau of Steam Engineering standard.

A diagram, the calculations for a 12-inch flange, and a table of stresses on

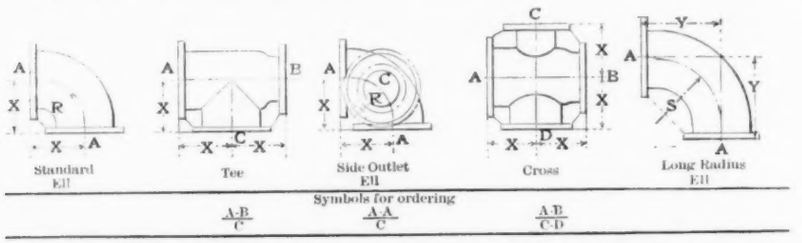
bolts due to 300 pounds pressure, are also given.

The pamphlet covers pipe flanges very thoroughly, and it is evident that Mr. Lovekin knows his subject.

Standard Cast Flanged Pipe Fittings.

BY A. H. NOURSE.

The accompanying tables of dimensions for L's, T's, Y's and crosses are used by all the large shipbuilding firms for the cast fittings used in piping arrangements. The patternmaker, when making his patterns, makes them in sections, so that a reduced branch can be cast if required. By having some shells of the required thickness to place in the core-box, but one box is required for making any fitting with reduced ends which may be needed.



Note:—For Tees and Crosses dimension X (center to face of any nozzle) to be taken to suit largest nozzle from which it issues. For instance in cross sketched above distance center to face of nozzles D and C, is equal to X for size A not for B; also distance center to face for A and B is equal to X for size D and not for C.
On side outlet Ells diameter of nozzle C must in no case exceed diameter of nozzle A Distance from center to face of nozzle same as X for A
Thickness of each nozzle to be as given under Body Thickness unless otherwise ordered
Thickness and diameter of flanges to be as given on standard flange list as ordered
Ribs as marked to be filled on heavy pressure cast iron fittings only unless otherwise ordered
Thickness of ribs to be the same as the largest adjacent nozzle.
Castings for Fire Main to be Sabined.

Inside Diam of Nozzle	X	Y	R	S	BODY THICKNESS. COMPOSITION: Under 151 lbs.	COMPOSITION: 151 to 300 lbs.	GRAY IRON: 0 to 100 lbs 8" & above; 0 to 150 lbs above 8"	GRAY IRON: 101 to 200 lbs 8" & below; 151 to 200 lbs above 8"
½	3		1¾		¼	¼		3/16
¾	3¼		2		"	"		"
1	3½		2¼		"	"		"
1¼	3¾		2½		"	"		7/16
1½	4¼		3		"	"	5/16	"
2	4½	6½	3¼	5	"	"	"	½
2½	4¾	7	3½	5½	5/16	5/16	½	"
3	5½	7½	3¾	6	"	"	"	9/16
3½	6	8½	4	7	"	"	"	"
4	6½	9	4½	7½	"	"	"	5/8
4½	6¾	9½	4¾	8	"	5/16	"	"
5	7	10½	5	9	"	"	"	11/16
5½	7½	11½	5½	9½	"	"	"	"
6	8¼	12	6	10	"	7/16	9/16	¾
6½	8½	13	6¼	10½	"	"	"	"
7	8¾	13½	6½	11	5/16	"	"	13/16
7½	9¼	14	6¾	12	"	½	"	"
8	9½	15	7	12½	"	"	"	7/8
8½	10	15½	7½	13	"	"	"	"
9	10¾	16½	8	14	"	9/16	5/8	1
9½	11	17	8¼	14½		"	"	"
10	11¼	18	8½	15		5/8	"	1 1/16
10½	11¾		8¾			11/16	"	
11	12¼		9¼			"	"	
11½	12½		9½			¾	"	
12	12¾		9¾			"	"	
13	13¾		10½			13/16	"	
14	14½		11			⅞	"	
15	15¼		11½				"	
16	14		11				"	

STANDARD L'S, T'S AND CROSSES.

Short Cuts on the Slide Rule.

BY CARL P. NACHOD.

As a toil-saver the slide-rule comes in for a great share of the benefits to humanity, so much so that it should be in the hands of everyone that does any calculating whatsoever, excepting, of course, addition and subtraction.

While there are a few operations for which it is not the most suitable means—such as the figuring of interest on large amounts, where absolute accuracy is essential, and perhaps calculating chords for subdividing a circumference—yet for the great majority of engineering calculations the accuracy of the ordinary 10-inch rule is more than sufficient for the data assumed.

When I think of the time I spent during one examination lugging around a precious (?) train of figures through various operations to find the efficiency of an engine from the coal to the pulley rim, I am reminded of the one thing I have against my *alma mater,* which is, that the advantages of the slide-rule were not insisted upon and its use made compulsory.

The following short-cuts on an instrument already quick have proved of considerable value for certain computations, and they can be readily extended by each one for his particular case.

They are the result of a generalization of the C line principle on a Faber rule. For brevity, denote the scales A, B, C and D respectively, beginning at the top. The C scale has two lines, one marked C at 1.128, and the other C_1 at 3.567, either of which may be used, the only difference being a change of the decimal point.

With these lines we can find the volume of a cylinder with a single setting of the rule. Take the case of a cylinder 5.4 inches diameter and 6.8 inches long. Put C_1 on the C scale over 5.4 on the D scale, and read the volume required, 156 cubic inches, on the A scale over 6.8 on the B scale. While the operation actually takes less time than to describe it, the operations performed are:

$$156 = .7854 \times 5.4^2 \times 6.8 \qquad (1)$$

or, generally,

$$z = k\,d^2 y \qquad (2)$$

If we use the C mark for this example instead of the C_1, it will be necessary to reset the B scale in order to bring the 6.8 on it within the A scale; and this shows the convenience of having both marks.

To discover how this is done, let A, B, C and D represent readings on the respective scales. The construction of the slide-rule is such that

$$\frac{A}{B} = \left(\frac{D}{C}\right)^2$$

or

$$A = B\left(\frac{D}{C}\right)^2 \qquad (3)$$

Putting (1) in this form, we have

$$156 = 6.8\left(\frac{5.4}{\sqrt{\frac{1}{.7854}}}\right)^2$$

$$\text{or } 156 = 6.8\left(\frac{5.4}{1.128}\right)^2$$

in which the scale for each quantity is given by its location with respect to (3).

Here we recognize on the C scale the value of the C line, which is seen to be the square root of the reciprocal of the constant in (1).

The value of C_1 is $\sqrt{10} \times C$.

Denoting the constant in (1) by k and the constant on the rule by K, we have

$$K = \sqrt{k} \qquad (4)$$

also $K_1 = \sqrt{10} \times K$.

As another application of form (2), suppose we wish to know the weight w in pounds of a cylinder d inches diameter and l inches long, of gray iron weighing .26 pound per cubic inch. The operation is:

$$.26 \times .7854 \times d^2 l = w$$

$$.204 \times d^2 l = w$$

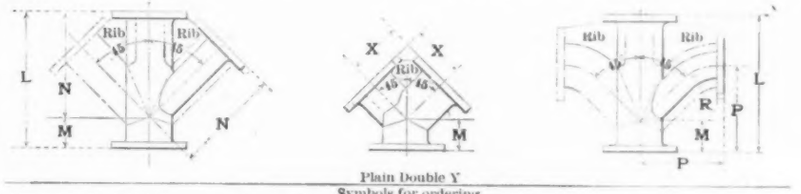
Comparing this with (2) we observe $.204 = k$, and by (4)

$$K_1 = \sqrt{\frac{1}{.204}} \times \sqrt{10} = 7$$

Put $K_1 = 6.7$ on C over 2 on D and read weight of solid rod, 64.2 pounds, on A over 72 on B. Put K_1 on C over 1.5 on D and read weight of solid rod, 36.2 pounds, on A over 72 on B.

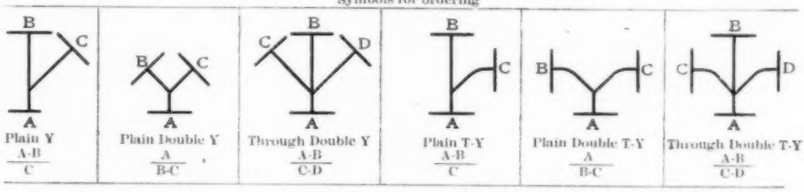
64.2 — 36.2 = 28 pounds, weight of tube.

This procedure is general and may be applied to any function of the form (2).



Plain Double Y

Symbols for ordering



Note:- Size of nozzle-B-C or D, must in no case exceed size of nozzle A
In all combinations of nozzles dimensions-L-M-N-P-R-X-depend entirely upon nozzle A
Thickness of each nozzle to be as given under Body Thickness unless otherwise ordered.
Ribs as marked to be fitted on heavy pressure cast iron fittings only-unless otherwise ordered
Thickness and diameter of flanges, to be as given on standard flange list as ordered.
Thickness of ribs to be the same as the largest adjacent nozzle.
For male and female flanges-dimensions as L-M-N-X-locating face of flanges are to be taken to outermost surface of flange thus:-

Inside Diam of Nozzle	L	M	N	P	R	X	BODY THICKNESS COMPOSITION.		GRAY IRON.	
							0 TO 150 LBS.	151 TO 300 LBS.	0 TO 100 LBS 8" & ABOVE 0 TO 50 LBS. ABOVE 8"	101 TO 200 LBS 8" & BELOW 51 TO 200 LBS ABOVE 8"
1¼	9½	2½	7	5	2½	3¾	¼	¼	3/16	7/16
1½	10½	2½	8	5¾	3	4¼	"	"	"	"
2	11½	2¾	8¾	6½	3¼	4½	"	"	"	1/2
2½	12½	3	9½	7¼	3½	4¾	5/16	5/16	1/2	"
3	14	3	11	8	3¾	5½	"	"	"	9/16
3½	15¼	3½	11¾	9	4	6	"	"	"	"
4	16¼	3¾	12½	10	4½	6½	"	"	"	5/8
4½	17¼	4	13¼	10¾	4¾	6¾	"	3/8	"	"
5	18	4	14	11¼	5	7	"	"	"	11/16
5½	18¾	4	14¾	12	5½	7½	"	"	"	"
6	20½	4¼	16	12¾	6	8¼	"	7/16	9/16	3/4
6½	21¼	4½	16¾	13¾	6¼	8½	"	"	"	"
7	22	4½	17½	14¼	6½	8¾	3/8	"	"	13/16
7½	23	4¾	18¼	14¾	6¾	9¼	"	1/2	"	"
8	23¾	5	18¾	16	7	9½	"	"	"	7/8
8½	25	5	20	16½	7½	10	"	"	"	"
9	27	5¾	21¼	18	8	10¾	"	9/16	5/8	1
9½	28	6	22	18½	8¼	11	"	"	"	"
10	28¾	6	22¾	19	8½	11¼	"	5/8	"	1 1/16

STANDARD Y'S AND T Y'S.

The weight of a gray-iron cylinder 5.4 inches diameter and 6.8 inches long is found by placing $K_1 = 7$ on scale C over 5.4 on D, and reading the weight, 40.5 pounds, on A over 6.8 on B.

In a similar manner weights of cylinders of other materials may be found, as, for instance:

Steel (.283 pound per cubic inch,), $K_1 = 6.7$;

Copper (.318 pound per cubic inch), $K_1 = 6.32$.

Find the weight of a steel tube 72 inches long, 2 inches outside and 1½ inches inside diameter.

Put $K_1 = 6.7$ on C over 2 on D and read weight of solid rod, 64.2 pounds, on A over 72 on B. Put K_1 on C over 1.5 on D

On examination of (3) it will be noticed that the form (2) is produced by putting the constant k on the C scale. Two other forms will be given by placing k on the B and D scales, respectively:

$$z = k \frac{x^2}{y^2} \qquad (5)$$

$$z = \frac{k\,x}{y^2} \qquad (6)$$

As an example of form (6) the electrical resistance of a wire varies directly as its length and inversely as its section, or as the square of its diameter. Furthermore, a 1-inch cube of copper at 20 degrees Cent. has a resistance of .00000068 ohms between parallel faces.

Therefore the resistance r in ohms of any wire of length l feet and diameter d inches is

$$r = \frac{12 \times .00000068\ l}{.7854\ d^2} = \frac{.0000104\ l}{d^2}$$

Here $k = .0000104$. Putting this in the form of (3)

$$r = l\left(\frac{\sqrt{.0000104}}{d}\right)^2 = l\left(\frac{.00322}{d}\right)^2$$

For functions in form (6) $K = \sqrt{k} = .00322$ and $K_1 = \sqrt{10} \times K = .0102$.

What is the resistance of 6,500 feet of copper wire .13 inch diameter?

Put .13 on scale C over $K_1 = 102$ on D and read the resistance, 4 ohms, on A over 6,500 on B.

For functions embracing square roots we may write (5) as follows:

$$D = C\sqrt{\frac{A}{B}}$$

reading the result on scale D. By placing the constant on scales A, B and C, repectively, we can obtain these forms for calculation at a single setting:

$$z = \frac{k\,x}{\sqrt{y}}$$

$$z = k\,x\,\sqrt{y}$$

$$z = k\sqrt{\frac{x}{y}}$$

It sometimes happens that a departure from the beaten track is of advantage. Take the equation:

$$y = \frac{x^2}{41}$$

Suppose that numerous values of x are assumed, and the corresponding values of y calculated, as would be required in plotting the curve of this equation. For instance, assume $x = 5$, then by the usual method we would place the index on 5 of D and move scale C so that 41 on that scale is brought in line with the index, and read the result .61 on A; and for each new assumption of x it would be necessary to move both the index and scale C.

If, however, we invert the equation, writing it $\frac{1}{y} = \frac{41}{x^2}$ we can obtain successive values without disturbing the index. Put the index on 41 of A, slide the C scale until the value of x, say 5, is in line with it, and read the result .61 on the B scale;

for any other values of x, merely slide the C scale and read the result.

At the risk of being considered impracticable I have endeavored in the foregoing, rather than give a list of constants for particular cases, to show how these may be derived. The utility of the various forms will be suggested by the special nature of the computation, and their saving in labor will be fully apparent when many calculations involving these forms have to be made.

The Fery Radiation Pyrometer.

The Féry radiation pyrometer illustrated herewith is intended for the measurement of the temperature of furnaces of all kinds, and it does this without the objectionable features of subjecting the sensitive or receptive part of the instrument to the temperature of the furnace. This instrument is located at some distance from the source of heat to be measured, no part of it being raised above the air temperature by more than 80 degrees Centigrade.

The radiation from a hot body, or which passes out through an observation hole in the wall of a furnace, falls upon a concave mirror or upon a system of lenses, as the case may be, and is thus brought to a focus. In this focus is a thermo-electric couple, whose temperature is raised by the radiation falling upon it; the hotter the furnace, the greater the rise of temperature of the couple.

The arrangement of the instruments is such that they are uninfluenced, within wide limits, by the size of the hot body or observation hole on the one hand, or on the other hand by the distance which separates them from the hot body or furnace.

The absorption of some small amount of radiant heat in passing through the atmosphere cannot, of course, be strictly without effect; but in practice the error thus arising is not appreciable. It has been found, for example, that the reading obtained for the temperature of a stream of molten steel was precisely the same—1,200 degrees Centigrade—whether the instrument was set up 3 feet or 60 feet away.

A complete instrument consists of telescope and galvanometer. Fixed within the telescope, at a point upon its optic axis, is the junction of a copper-constantan thermo-couple, arranged in the form of a cross. The two wires are attached to two brass strips D and R, which are attached to the terminals bb', Fig. 2. The terminals are connected by leads to the galvanometer, as shown in Fig. 1. To use this apparatus for measuring the temperature of a furnace, an observation hole in the wall of the furnace is sighted through the eye-piece o, the image of this hole being brought into coincidence with the thermo junction. It is essential that the image of the observation hole should *slightly overlap* the junction, which appears to the eye as a black disk in the center of the field of view. The readings of the instrument are then independent of the size of the observation hole. In the mirror instrument, the image of the hole is reflected to the eye-piece o by two small plane mirrors placed close to the couple. These mirrors serve for the adjustment of focus; they are so arranged that the image of the hole appears to be split into two parts, which only blend together to form an unbroken image when the focusing is correct. Fig. 3 illustrates the changes in the appearance of the field as the focus is altered.

The image thus formed upon the junction produces a rise of temperature, which is shown, experimentally, to be proportional to the amount of radiant energy which enters the telescope. The junction acquires exactly, and with great rapidity, the temperature of the image, but in no case does its temperature rise by more than 60 degrees Cent. above the atmospheric temperature. The electromotive force which is thus generated is measured by a highly sensitive galvanometer, whose scale is divided and figured so as to read temperatures directly. This galvanometer, notwithstanding its sensitiveness, is of substantial construction; it comprises a finely pivoted moving coil, provided with a long pointer. The movement of the coil takes place within a single air-gap between the poles of a strong permanent magnet. These galvanometers are invariable in their indications, and unaffected by all external influences. They are self-leveling, so that no adjustment of level is required before a reading is taken. By turning a milled head, the moving coil can be freed when a reading is to be taken, or clamped to facilitate the removal of the instrument. Another milled head enables the divided scale to be unclamped, adjusted in position to a small extent and reclamped, so that the reading is zero when no current is flowing.

The arrangement sketched in Fig. 4 is one used in taking furnace temperatures by means of the Féry pyrometer.

FIG. 1. THE FERY RADIATION PYROMETER IN USE.

In many industrial processes, a knowledge of actual temperatures is not essential, provided some standard is available which serves to distinguish between higher and lower temperatures, and enables correct heat conditions, once obtained, to be reproduced with certainty. Suppose, for example, that we are sighting the pyrometer on the metal in a crucible, and that the reading obtained on the temperature scale of the galvanometer is 1,100 degrees Cent. This may be lower than the true temperature, which we will suppose is 1,180 degrees Cent. If we find that the castings obtained by pouring the metal under these heat-conditions are satisfactory,

and better than those resulting from pouring either hotter or colder metal, we shall have reached the important practical conclusion that the correct pouring temperature for the metal in question produces a reading of 1,100 degrees Cent. on the temperature-scale of the galvanometer—even though we do not know the true temperature of the metal.

Since the energy radiated from a hot body increases very rapidly as the temperature is raised, it follows that the Féry pyrometer is far more sensitive at high than at low temperatures. Temperatures as low as 600 degrees Cent. can be read, but the instrument is most useful for high temperature work. As examples of high temperature measurements made with the Féry pyrometer, we may mention the temperature of the sun (7,800 Cent.) determined by Professor Féry, as well as the temperature of the iron in a thermit mold, which was found to be 2,500 degrees Cent. The instrument is thus of especial value for taking such high temperatures as those of molten steel, of gas settings, of glass furnaces, brick kilns and electric furnaces. Its great flexibility, and the readiness with which it is sighted, enable it to be used for taking the temperature of metal in a crucible just before pouring, thus insuring correct casting temperatures, a point which is now known to be of especial importance in the case of steel castings. Forgings, billets, blooms, and finished rolled sections are also readily followed through the various operations which have to be performed on them, great progress having already been made in this direction.

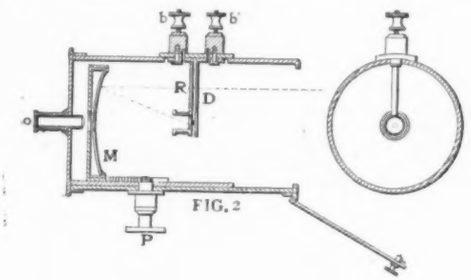


FIG. 2

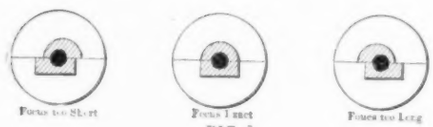


FIG. 3

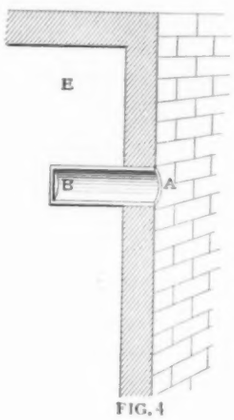


FIG. 4

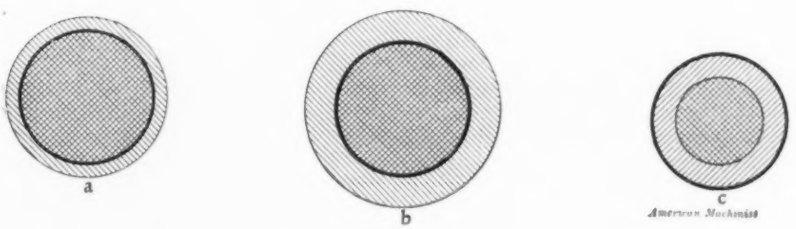


FIG. 5.

THE PRINCIPLE OF THE FERY PYROMETER.

A point which may need further explanation is the arrangement that insures that, within limits, the readings of temperature shall be independent of distance.

Suppose that we are sighting the telescope upon a hot body of limited dimensions. The *total* amount of radiation reaching the aperture of the lens or mirror will vary with the distance from the hot body, and will be inversely proportional to the square of the distance. If, then, the receptive surface of the thermo-junction were sufficiently extended to receive the whole of the radiation which is converged to a focus by the lens or mirror, we might expect the indications of the galvanometer to fall off as the distance was increased. The thermo-junction, however, is not large enough to receive the whole of the radiation which converges toward it. The real image of the source, formed by the lens or mirror, *overlaps* the thermo-junction on all sides, as shown at *a*, Fig. 5, so that, when we approach the source more nearly, thus increasing the size of the image produced, the only effect is to increase the amount of overlapping, while the thermo-junction receives no more radiation than before, as shown at *b*. On the other hand, if we withdraw to so great a distance that the image formed is too small to cover the thermo-junction completely, as shown at *c*, the readings obtained will be too low, and will become lower and lower, as we recede further and further from the source of heat.

From the above it will also be readily understood that when working at any given distance from the hot body, it is necessary for the body in question to be of sufficient size; otherwise the image of the body would be too small to overlap the thermo-junction on all sides. But provided the hot-body is large enough to secure the necessary overlapping, no further increase in its dimensions will add to the amount of radiation actually received by the thermo-junction. The diameter of the hot-body (or furnace aperture) should measure as many inches as the distance from hot-body to pyrometer measures yards.

A similar galvanometer is also made and calibrated so as to measure directly low temperatures, the temperature of liquefaction of gases, liquid air and liquid carbonic acid, or for the measurement of moderate temperatures between 0 and 600 degrees Cent. In such cases the galvanometer is connected by leads to a copper-constantan thermo-couple immersed in the medium whose temperature is required. The couple is enclosed in a tube which leaves the junction exposed. These couples should never be heated above 700 degrees Cent.

The sole agent for the sale of this instrument in America, Great Britain and her colonies, Norway and Sweden, is the Cambridge Scientific Instrument Company, of Cambridge, England.

The Effect of Wide Tires on Traction.

The effect of wide tires on traction on different classes of roads is well shown in some experiments made by the civil engineering department of the Iowa State College. The tires were 1⅝ and 3⅛ inches wide. On a well-drained earth road of good grade the traction with wide tires was a little higher with slushy snow and while the frost was coming out, and at other times it ranged 20 pounds less to the same figure as with narrow tires. On a badly drained earth road with poor grades, subjected to heavy travel, the wide tires required less traction than the others in dry weather and more when there was mud. On a well-built, well-drained gravel road, the narrow tires required less traction except when the surface was wet or covered with loose gravel. On a road of fine sand, with its surface flat with the ground, the wide tires required less pull in every case. On a well-drained gravel road with clay binder, the traction with narrow tires was lower than that with wide tires only when the surface was smooth and dry, and about the same facts were observed in experiments on a well-drained cinder road under heavy travel.

Of course this takes no account of the decreased traction for wagons of all kinds that results from the fact that wide tires conduce to good roads, while narrow ones will ruin the best road that can be constructed. The case for wide tires is by no means stated by comparing difference in traction. It is a matter of difference in roads or of cost of maintaining them.

Letters to the Editor.

Inventions and Patents.

If Mr. Allen's letter on "Inventions and Patents," page 1509, Vol. 27, AMERICAN MACHINIST, had appeared a few years ago, I should have concluded that we had worked for the same parties he refers to, but a more extended experience has taught me that there are others of the same ilk.

It is a human failing, or merit, that nearly all want to in some way distinguish themselves, and this is noticed in the shops as elsewhere. Young workers that have not been nipped a few times, are constantly racking their brains for new things to present to the boss, thinking that this will help them along.

Some years ago I obtained a position as superintendent in a shop doing a good class of work, and employing perhaps 150 men. As I was very young I started on the usual basis, part salary and part "glorious future." I cannot say how hard I worked, as I do not know of any units to express such things, but I got along quite well, and during the first year furnished ideas and worked them out for three patents on improvements, and saw no signs of disaster.

About three or four days before commencing my second year, the proprietor called me into the office and explained that since the company was losing money right along, it would be necessary to reduce expenses as much as possible, and that my salary would be $5 less per week for the coming year. The "excellent opportunity" would not be cut, and he dwelt at length on the good work we were doing, that it would be sure to command recognition, and then I would be remembered. I felt bad, but if such was the case, I would be willing to do my part, and in the course of time got him some more patents. No change was made in the salary at the beginning of the third year, but the company was still losing money, and I began to think it best to get in with some firm a little less unfortunate.

One evening, in the beginning of the third year, I was in the office talking to the old bookkeeper, and naturally our conversation drifted to the hard times. Wearily putting a big book in the safe, he said, "If I had the income of the old man I would not worry." This interested me, and on getting friendly with the old bookkeeper I learned that it was possible to form a company with dummy partners, to rent grounds, buildings and machinery to said company, charge them salary as president, commissions and royalties on patents, etc., and thus I learned my first lesson in finance. It was actually a fact that my inventions were hurtful to the company, because the more patents, the more royalties for the old gentleman, and partly the reason the company could not pay me more wages.

I took a dislike to this proprietor, but had to realize that he was a smart fellow, and it is quite likely that I did not lose much, because if I had no better sense than to hand out my ideas, depending on charity for reward, it stands to reason that I could not have made much better use of them in any other way.

This same proprietor used exactly the same tactics as described by Mr. Allen, in adding a little here and taking off a little there on unimportant dimensions, so that he could claim it all as his own. The glee of consequent disaster was never mine, however, as he was too good a mechanic for that, and a gear, for instance, is not necessarily doomed to destruction if its already sufficient face is widened ⅛ inch or so. I gradually got the idea that he must be about the meanest man living, but I have since met as bad or worse.

Another favorite way with some proprietors or managers is to have a regular shop order issued for whatever may be suggested to them, and this same order, properly signed by the manager and dated, becomes proof positive of his invention. This method is no doubt the best, as there is no need of worrying about the dinky little details. The drawing room and shop will attend to that. If it were not for the new recruits, the patent list of this kind of managers would ordinarily be short, as they are quickly found out by the older hands, who then are through looking for that kind of distinction. These small improvement ideas are usually not of much value to the shop-man inventor, and it would be impossible for him to realize much on them, and for this reason it seems strange that men who ought to know better are willing to sacrifice so much of the respect of others. They would be considered just as smart and far more manly if they obtained the use of their employees' ideas by fair means, and the results would undoubtedly be better. The only remedy lies perhaps in better education, as human nature, left to itself, is not liable to change very radically.

The shop I referred to above is well known, and in my innocence of the ways of the world, I thought that being superintendent of it and having entire responsibility of the mechanical affairs for some years would in itself be a recommendation, and that, on the strength of this, I would be taken at least on trial most anywhere in the same line of work. I found, to my disgust, in looking for another position, that it counted for but little. The only thing my prospective employer wanted to know was what my present firm thought of me, and then I commenced to learn another important lesson. I must confess that I had not paid a great deal of attention to matters polite. I never intended to be disrespectful, and never felt it; but if things did not suit me, I never hesitated to say so, and at the time of making a change I got it back with interest. The "recommendation" they furnished was a ripper. Fortunately for me, they overdid it so that it looked as though, even if they would not object to let me go, yet they would do what they could to keep me away from a competitor; and by the crossing of purposes I got the new job. I have been tossed over once or twice since, and it is ever the same—not what can and will you do, but what does so-and-so think of you?—and the lesson to be learned is, that it requires two kinds of ability, far distinct from each other—the ability to do the work and the ability to get along; and the latter will oftenest be called for. Where one person only is to be pleased the difficulties are less, but if several are to be made to think they are the only thing that ever happened, it is not so easy. I do not have in mind so-called out-and-out suckers as being first in line for success, but the man that knows how to please without apparent truckling.

There is, nevertheless, a reason for the unwillingness on the part of managers and proprietors to take a prospective foreman or superintendent at his word. It is misrepresentation on the part of those looking for jobs. In advertising for a foreman for an ordinary machine shop, for instance, upward of a couple of hundred of replies may be received, and among them will not be found one who does not feel competent to handle the job; but it will not take long to discover that only a few would be satisfactory, and about the only thing to do is to let someone else select for you. If the job is for a superintendency, the number is much greater, and for one such job I counted over 460 applications by letter. PERCY.

Lining a Marine Crosshead.

In the usual type of marine crosshead, the adjustments consist of two slippers of gray iron, attached to the enlarged end of the piston-rod by oval holes and cap-screws. As wear takes place, the slippers are set out to the guide faces by liners of requisite thickness inserted under them to take up wear.

A ship in the Atlantic trade gave a lot of trouble with the high-pressure engine, the packing of the rod leaking badly most of the time; and pack in what fashion you might, the gland never lasted tight to the end of the trip. I received orders to overhaul the high-pressure crosshead, and upon investigation, the *astern* slipper had a 5-32-inch liner under it, while the *ahead* shoe a 1-32-inch liner only. As the engine wears fifteen days on the ahead guide, and only an hour or two on the astern during any ordinary trip, I proceeded to readjust matters by bringing the astern shoe metal to metal, and lining out the ahead side to fit.

When completed, I had a visit from the chief, and explained to him what had been done; showed him how the ahead side of the rod was scored by the packing, and proved to my own satisfaction that

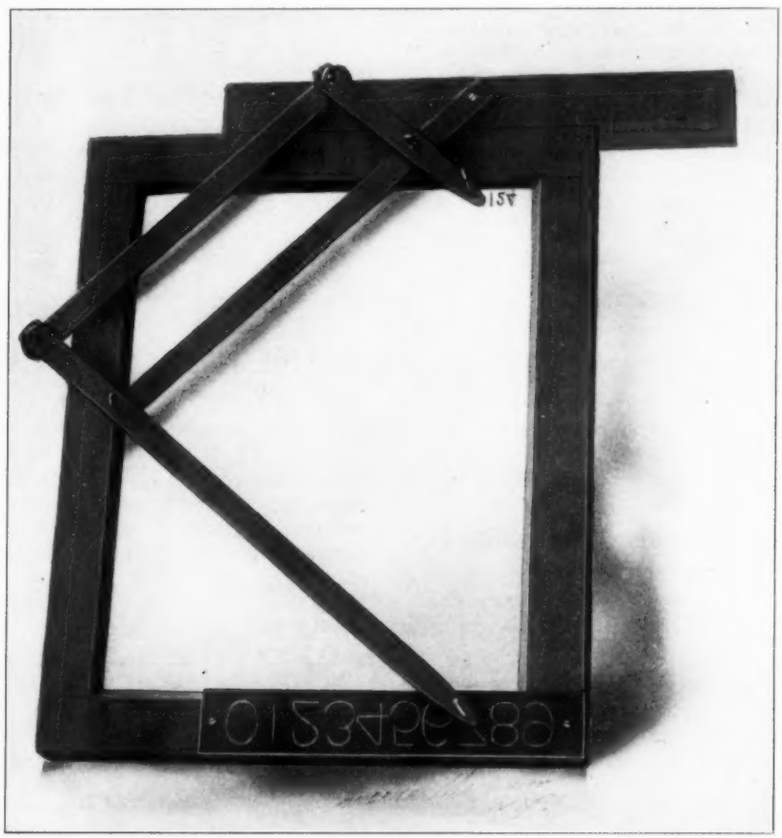
the engine was now in line; but all to no purpose. We had the old order of things reinstated. Had the adjustment remained the packing would certainly have lasted longer; the engine was grinding the gland and neck bush, and looked like scoring the rod past the ability of any packing to keep tight.

The steamer still makes her round in the same seas, and I often wonder if there is a chief aboard who knows that a marine engine always wears her guides in the one direction. A. L. HAAS.

London.

A Tool for Numbering Negatives.

The illustration shows a tool for the convenient numbering or marking of photographic negatives.



A TOOL FOR NUMBERING NEGATIVES.

A brass strip with the inverted numbers 0 to 9 cut into its face is screwed to the edge of a printing frame, and a small pantograph is constructed of light ash strips and brass screw-eyes. When it is desired to number a negative, the plate is put into the frame, dull side out, and the figures picked out and transferred neatly and quickly from the brass strip to the negative. The wooden block to which the pantograph is attached is held lightly against the frame with the right hand while the left traces the figures; the block being slipped backward or forward to give the proper spacing.

It is thought that the economy of the tool lies in keeping it with its printing frame always in a drawer of its own ready for use, so no time is lost preparing or assembling the parts.

GEORGE F. SUMMERS.

An Electric Object Lesson.

A big liner was driving ahead through the English Channel with an extra watch of engineers on "stand-by" duty in the engine-room, as there always is when the ship is in narrow or crowded waters, so that in case the engines have to be stopped or reversed, they may be operated with the utmost dispatch. The "stand-by" engineers take no other part in the active duties of the watch. Those referred to here were discussing modern advancement. One remarked that, although the ship had a fine electric-light installation, the owners did not evidently depend on it or believe in its reliability, as they had fitted out the engine-room with a complete outfit of oil lamps also.

"Well," remarked another, "I guess they had an object-lesson in the case of the old 'Caroline.' When she was a new ship the owners gave a banquet to numerous patrons of the line. The electrician had instructed his oiler to look particularly well after his engine that evening, and the fellow got so nervous over his responsibilities that he went ashore and had a few 'cool ones' to brace him, with the result that he neglected his duty—got a bearing melted out, and just in the middle of the banquet the whole ship was plunged in darkness."

"Yes," remarked another, "it is queer how these things happen at the worst time. I remember that in one ship I was in we had three electric engines and had broken a crankshaft in one of them. The new shaft was put on board a few minutes before sailing the next voyage, and we had not had time to fit it in place. We were going down channel the first night after leaving port, and the engineer on duty was feeling around the two other engines—which were carrying a pretty heavy load—when he observed a slight wobble on the fly-wheel of one of the machines, and before he could take any steps to investigate, the shaft of that machine broke close to the fly-wheel. The governor at once stopped the engine. The passengers were at dinner in the saloon, and, knowing this, the engineer at once switched the saloon lights over to the only machine now running. This overloaded that machine; the main fuse went, and every light in the ship went out."

The first assistant had been listening to these yarns, and he at once gave orders for the oil lamps to be lit around the starting (operating) platform, for, as he remarked, "We've been sailing without any accident for several years, but one never knows what might happen." Several of the others present smiled at his remark, as the ship was equipped with electric machines by one of the best firms in the United States, and they had plenty of surplus power. That night, when the ship was docking and the engines were being started, stopped and reversed with all possible speed, the main fuse on the starting platform burned out and the platform would have been in darkness—with the certain result of many thousand dollars' damage to their ship, other ships or the quay walls, as the telegraph signals from the bridge would have been invisible—but the steady glow of the oil lamps saved the situation, and all concerned took the incident to heart as an object-lesson and an emphatic endorsement of the old injunction, "Never put off till to-morrow what you can do to-day."

J. R. M.

A Fish-Line Belt.

In answer to the reader of the AMERICAN MACHINIST (page 403), who is constructing a number of machines in which he is using a small fish-line for a belt, and is having a good deal of trouble with this fish-line belt, the best advice to help him is to follow the general rules of rope belting, which in this case will suit perfectly. The wheels must have the proper V-shaped grooves, so that the lines do *not* touch the bottom of the V-groove, and the wheels must be at least 25 times the diameter of the fish line; then the best results will be obtained.

New York. ADOLPH J. SPITZ.

In Re Directors Who Do Not Direct.

Referring to your editorial at page 510, I take no exception to your statements as to the present relation held by directors (so called) to the management (and often mismanagement) of corporations, as you say nearly all who have knowledge of such affairs are lamentably aware of their existence. However, I do not condone and ratify the conditions as stated, nor does the public generally, as witness the present tidal wave of sentiment against mismanagement that is sweeping over the length and breadth of this country; and it seems very queer that a publication of your standing should say, in effect, the present method is good enough, it can't be improved. If such be the case, why have a directorate?

A proper board of directors, consisting of persons willing to conscientiously perform the duties devolving upon them, should be a power for good and profit to the concern with whom connected. You say they can't be expected to devote time and take an interest in directing, because they are not on the payroll. However, if they did take the time and devote proper energy and acquire a knowledge of the business and conditions, would not the increased dividends and enhanced value of their bonds and stocks be good and sufficient compensation for efforts put forth?

You say these busy business men haven't the time. Isn't anything in which they invest a portion of their money a part of their business, and as such worthy of consideration to that extent? Then, too, a director is, in a sense, a public officer to the extent of the stock- and bond-holding public, and as such an officer, has a duty to perform beyond his personal and private interest.

Any fairly intelligent man can acquire a knowledge of the business with which he is associated in the capacity of director by application, and to say they cannot, is to impeach them as to their fitness for such position.

You speak of "usurpation of authority and an appearance of officiousness" by directors who attempt to interest themselves in the affairs of corporations with whom connected. Well, a management that can't stand the intelligent, kindly, sincere efforts at attempts to help them by the council and knowledge of affairs of said directors, should be superseded, and if bond- and stock-holders would arise and demand that directors direct, and only such persons be allowed to serve as are willing to devote time and energy to same, then would present conditions cease to exist, and an era of peace, prosperity and plenty, follow.

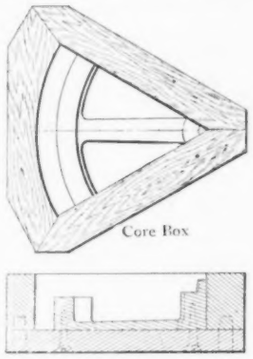
SIDNEY W. BRAINARD.

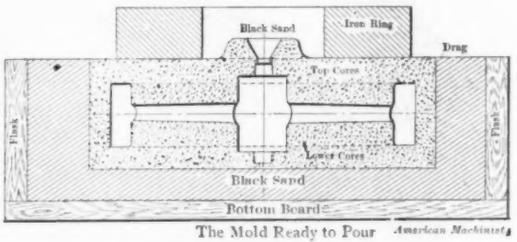
[So far from saying that the present condition is good enough, we said "that the condition is a desirable one it would be idle to claim," and we added "that it can be easily changed it would be equally idle to believe." We simply recognize the condition that directors are expected to do a lot of work without pay, and to this we attribute the fact that the work goes undone. It seems to us that a demand by bond and stock holders that others work for them gratuitously would be looked upon as a queer sort of demand and that it would lead to few results.—Ed.]

Economical Method of Molding Special Gears.

Having occasion recently to get out several special gears and some iron patterns for both gears and pulleys, no wooden patterns for any of which were available, the question of their economical production was satisfactorily and quickly settled by the following expedient, which is much the quickest and cheapest method for handling such work I have yet seen.

The sketches will explain the method without much comment. A wooden blank was turned up a couple of inches larger in diameter and a couple of inches thicker than the largest of the patterns or castings to be made—the several pieces varying in size by but a few inches in diameter and thickness—and this blank was used as a pattern, in the drag, for all sizes to be made.





COREBOX AND MOLD.

The main core-box was made as a segment—one-sixth for a six-arm gear or pulley—of a circle of the same radius as this blank, and its depth was half the thickness of the blank. The bottom board was made loose, and to it was attached, by screws, the only part of the pattern proper made, a sector of one-sixth (in this case) of the gear or pulley blank and one-half its thickness, using of course double shrinkage and double finish for a metal pattern and single shrinkage and finish for a single casting.

The segmental pattern is band-sawed roughly to shape and finished to templets by hand. As many bottom boards as there are patterns, etc., are made for the core-box, and to each is attached a segment of one of the required pieces. When a piece is wanted, twelve cores are rammed up and placed in the drag receptacle made by the plain disk and weighted down by an iron ring, no cope being used. Gating and venting are done as usual. The hub may be solid, cored or have prints attached, the arms may have any size fillets and rounds, or be a web if desirable; one face of the blank or hub can be easily made different from the other, or any alteration in the pattern can be readily effected. It is even available for gears with teeth cast in if carefully handled, and has been proven satisfactory over a large range of work.

T. A. SPERRY.

A Peculiar Break of a Bar of Steel.

Referring to J. P. Brophy's letter at page 415, we are in the habit of using the butt ends of cold drawn shafting in our work, and I very often have seen pieces break off in the manner described, and always supposed they were fractured in drawing. One piece broke in the lathe after it had been annealed, showing a bright grain. Mr. Brophy does not state that it was drawn steel that he used.

W. D. MCKAY.

The Compound-Rest Tool Clamps.

I must beg to take exception to the statement made by E. H. Fish at page 528 that the compound rest is seldom used more than once a year on more than one lathe in fifty. This may be so in many cases, and yet, to my mind, a graduated top slide is a most useful adjunct to any lathe used on all-around shop work. For instance, how much easier and quicker can U. S. S. and V threads, especially the coarser pitches, be roughed out with the aid of a top slide set at 30 degrees than with a tool held in a plain rest. Bevel gear blanks are another case in point. The compound rest furnishes a ready and positive means of obtaining the face and back angles with certainty. Many other instances could be mentioned, especially when a job beyond the usual capacity of the lathe has to be executed. I once had to make some 1-inch-pitch worms on a light 13-inch lathe. By setting the rest at 14½ degrees I had no great difficulty in cutting the thread. I used this angular feed both in roughing and finishing, and did the job in what was considered very fair time, considering the circumstances.

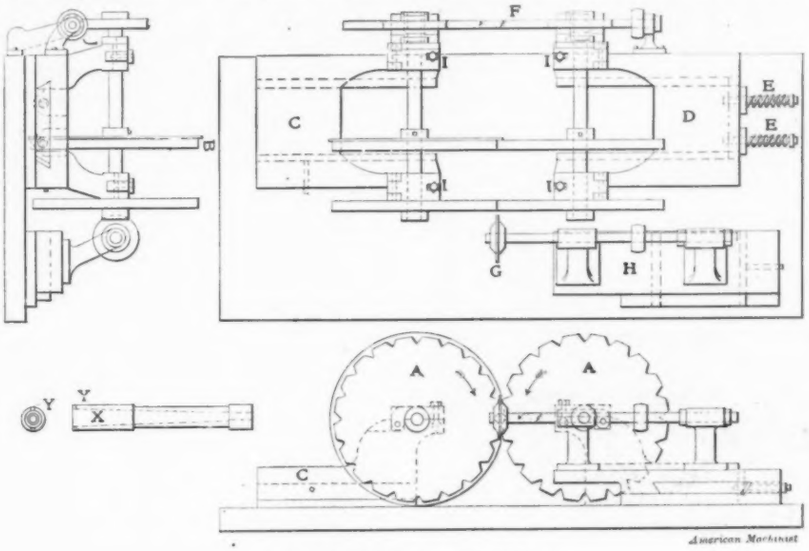
As regards the tool clamp illustrated in Mr. Fish's Fig. 9, I have nothing but praise for it. I have used a similar one, with the center stud very stout (1¼ inches

diameter with 12 threads for a 13-inch lathe), and a stiff coiled spring under the top plate, and found it a world-beater, especially with cutting-off tools. It must be used to be appreciated.

JOHN P. WHEELER.

A Machine for Sawing Slots.

This machine—of which three views are shown—was built to perform the operation of slotting the end *Y* of the piece of work



A MACHINE FOR SAWING SLOTS.

of gray iron shown at *X*. The machine was designed and built by the overseer of the job on which these pieces are made. The first time I saw it I was passing through the room and heard a noise somethink like a siren whistle and buzz-saw combined. Going over to where the noise came from I found a boy on the jump feeding work into the machine. When first thought of it was intended to have it automatic, but when built and its capacity seen, it was found cheaper to run it up to the limit and have a boy feed in the work. The machine has a capacity of 3,000 pieces per hour. Larger sizes of work can also be handled on the machine, as there are adjustments provided with that end in view.

The sketches shown give a general idea of how the machine was built. The gray-iron disks *A* carry the work in the groove—cut on the edge to match each other—the flange *B* acting as an end stop to bring the work into correct position. The slide *C* is locked, the slide *D*, by means of the springs *E*, furnishing the pressure to hold the work in the grooves while passing the saw. The studs which hold the springs have adjusting nuts to keep the tension just right. The disk shafts have each a worm gear on the end, one right and one left hand, and are driven by worms on the shaft *F*.

The pinions are splined to the shaft and move with the slides. The saw *G* has fine teeth and runs quite fast, about 300 revolutions per minute, it is about 4 inches in diameter. The saw table *H* is adjustable and is locked by a set-screw.

In changing to a larger size of work it is necessary to change the disks which are held by set-screws on the shafts. To facilitate the removal of the shafts the caps of the boxes *I* are hinged, and a change over is done in very short order.

There is a hopper—not shown—on top of the disks, into which the work is placed and from where it drops into the grooves in the disks. Each worm runs in a case *J*, which is bolted to the slide.

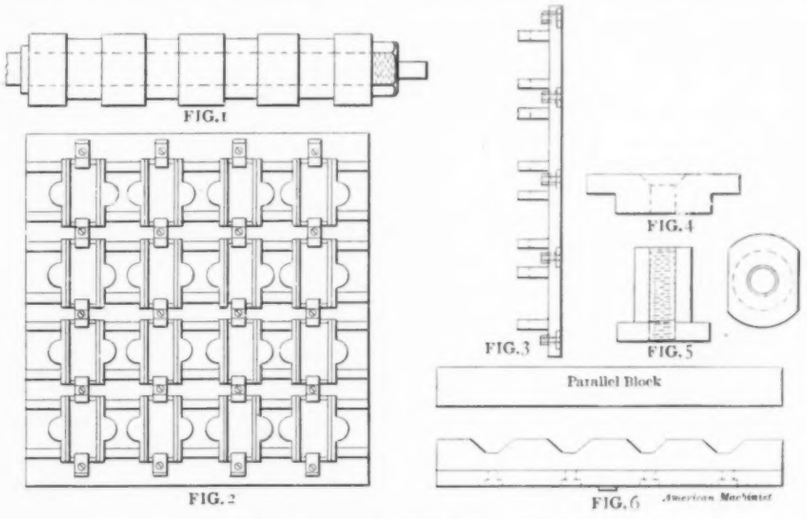
PAUL WESLEY.

Gang Milling of Machine Bearing Caps.

Being given a lot of caps to mill, I looked around for some fixture for holding them, but all I could find was a small affair which held one cap. This did not seem very up-to-date, so obtaining permission from the foreman to build a fixture, I designed one to hold forty-eight at one setting. Figs. 2, 3 and 6 give a general idea of one section of the fixture, which holds sixteen caps, four abreast. Three of these sections, holding forty-eight caps, filled the platen of the milling machine. Each of these sections had a tongue planed on the bottom, lengthwise of the casting, to fit the slot in the platen. After the tongues were planed all three were finished together to insure that the V's came in line. The V's were spaced far enough apart, to allow the caps to rest in them without the ears interfering, and the leveling up was simply a matter of laying a heavy parallel across the tops, as per end view at Fig. 6. Small straps, which acted as spacers, were shouldered as at Fig. 4, to act as thrust blocks as well as straps. These were made so as to allow the head of tap bolt to come below the cutters. These tap bolts were not screwed directly into the iron fixture, because stripping the thread might occasion considerable annoyance, if not ruin the fixture. Steel bushings, as Fig. 5, were made on the screw machine and tapped to receive the tap bolt. These bushings were pressed into the fixture from the bottom, which had been milled out with an end mill to receive the flatted head of the bushings. This allowed the bushing to be removed in case of accident, and replaced without injury to the jig. Special cutters were made the right width to make up the required distance, without the need of spacing collars.

Fig. 1 shows how the cutters looked in position. When this fixture was ready for work, a boy milled 100 per cent. more caps with it than a man did by the old method, in the same length of time. Requiring no setting or measuring other than the first, the operator had considerable leisure time on his hands to devote to other things.

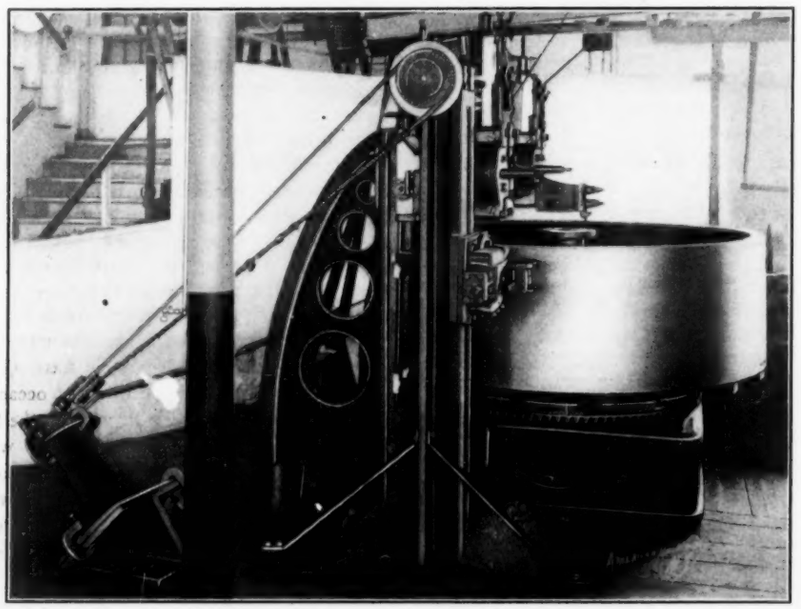
DENMARK.



GANG MILLING OF MACHINE BEARING CAPS.

Machining an 8-foot Pulley on a 6-foot Boring Mill.

The title states the problem that was "up to" our foreman, or rather, there were eight of those pulleys, 8 feet diameter by 2½ feet face, to be turned on a Sellers boring mill designed to take work up to 6 feet diameter only. By moving back the housings of the mill and using supporting extension irons which bolted to the table, enough room was obtained for mounting and revolving the pulleys in question. It was then found that this arrangement allowed the tool to travel down but half the face of the pulley before the head struck the top edge. By using an extension head which held the tool and bolted to the regular head, it was thought that the remainder of the face could be finished, but a trial produced a rough surface full of chatter marks and led to the adoption of the device shown in the photograph.



MACHINING AN 8-FOOT PULLEY ON A 6-FOOT MILL.

The bed of an old lathe was resurrected from its long repose in the basement and set up endwise, as seen at the left of the machine. Fortunately, it had a long lead screw running down the center, which was moved by worm gearing at the end. The heavy carriage was also intact, and in this was inserted the tool. After vertical alinement, the bed was securely bolted to the crosshead slot and otherwise braced, giving a very solid support for the tool. A rope drive—taken from the feed cone at the right of the machine and led over pulleys supported by grinder columns in the rear—turned the lead screw through the gearing mentioned.

At the right also, the regular head of the mill was adjusted with cross feed to face off the top edge of the pulley—the two tools to move simultaneously.

The results obtained from the arrangement described were in every way satisfactory, the finished pulleys being entirely free from chatter marks; they were also turned out with pleasing expediency.

CHAS. G. RICHARDSON.

Straightening Gun Barrels.

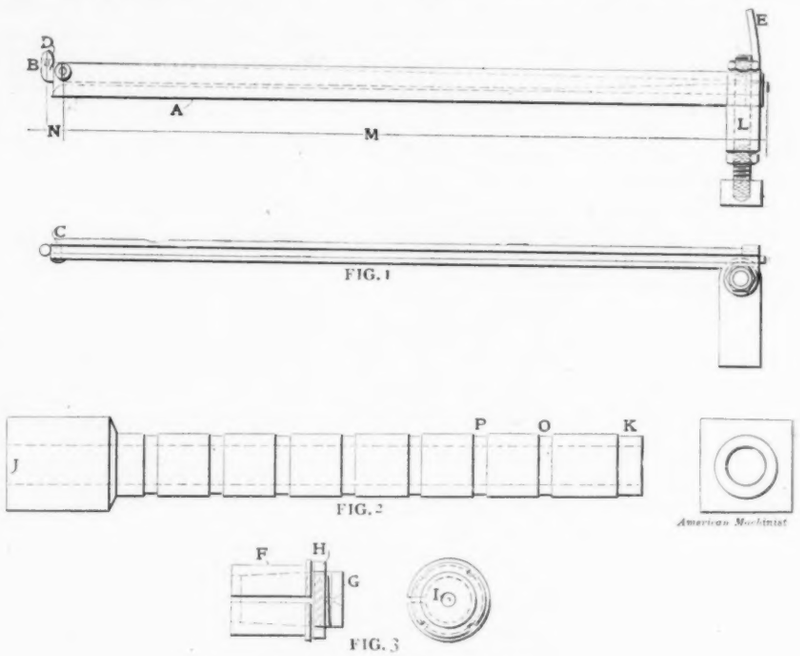
The most difficult operation in manufacturing a gun is the boring of the barrel. While it is possible in guns of large caliber to bore a hole straight enough, using large boring heads, guided by brass pins, the boring of small guns—for instance, those of 2 inches caliber—is a harder task. Gun barrels of such small diameter have to be straightened after being bored.

The straightening operation is easier than would at first appear, using the simple indicator shown by Fig. 1. It consists of steel piece *A*, grooved to receive arm *B* that pivots on pin *C*. At one end *B* has a brass tip *D*, and the other end is pointed. A small quadrant *E* is screwed on *A*, as shown.

Fig. 2 shows the gun barrel, 2-inch bore. It has been roughed down all over to see if the material is defective, and then bored, one end being chucked and the other end resting on a steady rest.

A center, as illustrated by Fig. 3, has to be made. This consists of split bushing *F*, which is of the same diameter as the bore of the barrel and bored taper. Center plug *G* is turned taper to fit bushing *F*, and has a nut *H* to remove it from the bushing. Center *I* must be made with great care. End *J* of the barrel is now chucked and the center, Fig. 3, put in place. The small space *K* is turned at the end for the steady rest, and the latter is put in place, and the center *F G* removed.

The indicator is now secured in the tool-post. The body *A* has a hub bored to receive a pin *L* that has two nuts to hold the indicator at any desired point. A small feather prevents *A* from turning on the pin. The indicator is introduced in the barrel, so that tip *D* will be about five inches from end *K*, and raised on pin *L* as much as necessary to bring the brass tip into contact with the inside of the barrel when the latter rotates. Of course, any imperfection of the barrel at that point will be greatly magnified by the point of the indicator. End *J* of the barrel is shifted in the chuck until the indicator point is still; then a small flat *O* is turned on the surface exactly opposite the indicator tip inside. The indicator is then



STRAIGHTENING GUN BARRELS.

introduced five inches further, at *P*, and that point of the bore trued up, and the corresponding outside point turned as before. In this way a number of flats are turned on the outside of the barrel, at a distance of 5 inches from each other, each one true with the corresponding point of the bore.

By straightening the work with a hydraulic press until all the spots turned run true, the bore will also be straightened.

J. M. MENEGUS.

Material Lists for Electrical Apparatus

I have been in various shops, from the small one, where the same man acts as general manager and office boy, to the large corporation controlled by a "captain of industry," and in all of these places I have found the same cry throughout for material.

This is due, of course, to several causes, but the one which has interested me particularly has been the lack of information in the ordering and engineering departments concerning standard sizes, which must be carried in stock and which should be followed in the making up of new designs.

Where I am at present, we have endeavored to take care of this, with considerable success, by preparing in the drafting room a number of sheets, as shown in the accompanying print. On these sheets we have shown on certain standard lines both the total amount of any one size of material required for all of one class of apparatus, and also the number of different kinds required for any one particular class.

Thus, referring to the sheet on fillister head-screws, item No. 6, reading the column from left to right, gives us the total number of 8-32x¼-inch brass screws which are used; while group *R*, reading from top to bottom, gives us the total number and different kinds of screws which are used in making up frame No. 6. Other sheets give the amount of copper and brass stock required for circuit breakers, etc.

The writing in the description column gives the class of apparatus on which this material was first used.

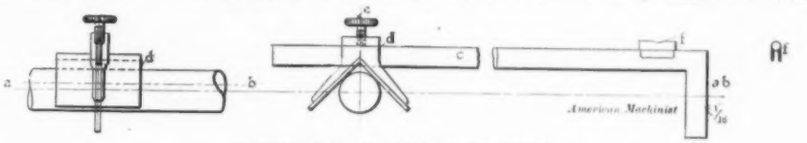
While these sheets have not entirely obviated our troubles, they have gone a long way and have put the matter on a much better basis than when the material is handled in a haphazard sort of way.

By having sheets with the title printed on, such as we use, using writing instead of printing, and using a fountain pen filled with Higgins' Eternal Writing Fluid, the labor of preparing the sheets has been small.

C. C. B.

Instrument for Lining Shafting.

I was much interested in the article under the above heading at page 254, and give here a sketch of my design of an instrument for the same purpose. In the sketch, *a b* is the line to which the shaft ought to be parallel horizontally; a square *c* slides in the slit of the head *d*, and may be clamped by the screw *e* to this head; a level *f* is put at a convenient place on the longer edge of the square.



INSTRUMENT FOR LINING SHAFTING.

After first securing the line *a b* so that its two ends are at the same horizontal distance from the ends of the shaft to be lined, we put the head *d* on one end of the shaft and slide the square in the slit of the head until its vertical edge is about 1-16 inch or so from the line *a b*, while by the level *f* keeping the longer edge of the square horizontal. Then by the screw *e* we clamp the square to the head. We then proceed along the shaft, putting the head *d* on the shaft and leveling the square to see whether the line *a b* be just at the same distance from the vertical edge of the square as when the latter was adjusted at the end of the shaft.

By this method it is not necessary to know the varying diameter of the shaft, and no scale or graduation is wanted.

H. IWAOKA.

Should a Machinist Sit While Working?

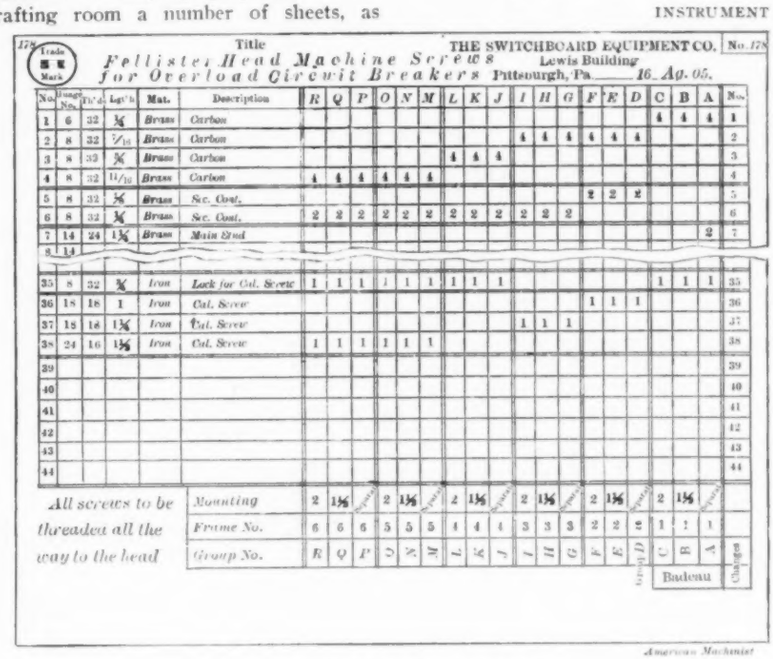
The illustration on the front of the cover of a recent issue of the AMERICAN MACHINIST forms the subject for quite an interesting train of thought. It depicts, you will remember, an operator sitting in front of a radial drill, showing how easily he reaches all handles. The interest is not so much in the machine as in the position of the worker. It is possible he was shown sitting because in that position he is able to manipulate the levers more easily than if he stood, and that it is a new departure for machinists in America to sit down to work where it is possible; but I do not think so. The point of the illustration would be in a great measure lost if the man was in an unaccustomed position. If, as it seems to be, workers can and do sit down, with full permission of their superiors, it shows a broader-minded policy than exists in England. Here—and I think much the same conditions exist on the continent—it is extremely unusual for anyone to sit down to work in the shop; that is, with the consent of the management.

Standing in one position for ten hours is a strain unrealized by anyone who has not done it; it is much greater than if one is moving about all day. That is, it is more tiring to stand working a small lathe or a press than it is to work for the same time erecting or any similar work that requires movement of the body. There are many jobs which could be done quite as ably, and with much less fatigue, sitting down as standing up. To stand in these cases is obviously a waste of energy, which if saved might be expended in increased production. That it is the employer's duty to himself to eliminate all waste work on the part of his men should be as evident as it is to lessen friction in a bearing, or to have economy of fuel in the stoke-hole.

H. T. M.

Manchester, England.

[In American shops—with few excep-



SCREW LIST FOR CIRCUIT BREAKER.

tions—a workman may do his work in any position, either sitting or standing, so long as the results are what they should be. In a number of shops comfortable stools are furnished; in others the "harmless, necessary" soap-box or nail-keg supplies the "long-felt" want.—ED.]

Bevel-Gear Formulas.

At page 435 I noted a criticism by E. H. Fish of a previous article on bevel-gear formulas, with some additional formulas, which, in my opinion, offer a long and laborious path to reach the desired results. To prove this, I offer the following formula, and wish to point out that it

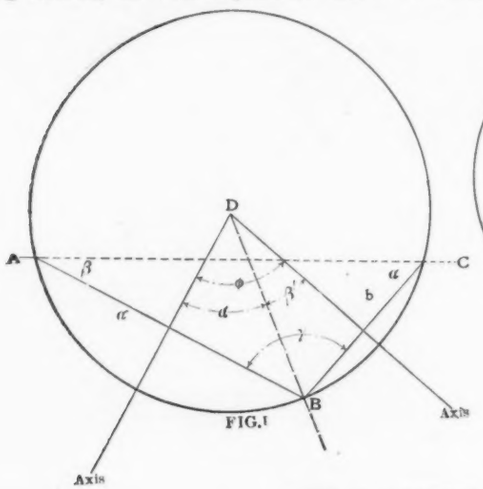


FIG. 1

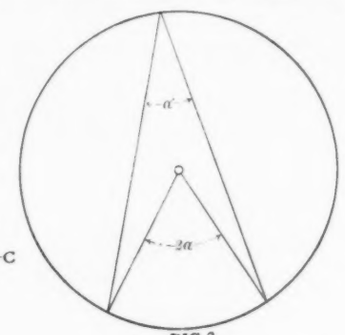


FIG. 2
American Machinist

BEVEL-GEAR FORMULAS.

stands for acute angles of axes, as well as for obtuse angles, and that only one function of an angle is needed.

In Fig. 1, a and b represent the two pitch diameters, or the ratio of the gears, and ϕ is the angle between the shafts, point D being the center of a circle on which the ends of a and b, called $A\,B\,C$, lie.

After connecting A and C, we get a triangle $A\,B\,C$, with the sides a and b, and the included angle γ given, γ being equal to 180 degrees $-\phi$, and leaving only α of the triangle $A\,B\,C$ to be determined. This angle α is then equal to α', the pitch angle of the gear with the pitch diameter a, because we know that the circumference angle is always one-half of the center angle which rests on the same arc, as shown in Fig. 2.

To find the value of α I use the equation of the tangent:

$$\tan.\frac{\alpha-\beta}{2}=\frac{a-b}{a+b}\times\cot.\frac{\gamma}{2}$$

by adding the angle $\frac{\alpha+\beta}{2}$, which equals 90 degrees $-\frac{\gamma}{2}$, I get the angle α.

$$\frac{\alpha-\beta}{2}+\frac{\alpha+\beta}{2}=\alpha$$

The pitch angle of the other gears is, of course $=\phi-\alpha$.

DESIGNER.

Cutter Grinding in Small-Arms Plant.

There is no question but what Herbert V. Purman would meet with several surprises if he should visit some of our small-arms plants, for there are a great many operations performed in those places that seem impossible to the uninitiated. It certainly does seem impossible for a man to guide a formed mill by hand, but the efficiency attained by some of the men employed at this business is attained only by practice.

The using of formed mills at gun shops is quite a study. I have known of some extensive experiments being carried out on this line and have found by experience that the saw-tooth form of tooth on large gang mills gives better results than the eccentrically formed tooth; a mill made with saw teeth and properly hardened will make from one to three thousand cuts before regrinding is necessary, which I have found by experience that no other shape of tooth will do.

Another reason the saw tooth is preferable to the eccentrically formed tooth on this work is because of the smooth cutting and easy pulling on the belts, as the saw-tooth mill, having more teeth than the other, gives more cutting teeth in the same radius.

Take, for instance, a mill for the trigger guard plate; no one with any gun-shop experience would think of making a formed mill for this piece with any other but saw teeth, as the different diameters on this kind of mill would make it almost impossible to space the teeth so as to present an even cutting edge.

Mr. Purman also speaks of the accuracy of formed mills, and states he has made mills that bring the work well within the limits of .001 and .002 of an inch; this is truly remarkable, as I have found it almost impossible to make a mill work as closely as that without grinding after hardening.

I have used a great variety of formed mills made by some of our noted small-tool making companies, and even in gear cutters have rarely found a mill that would come within the limits named.

C. A. HUNTINGTON.

Turning Machine-Steel Rings.

The illustrations show a rapid method which we recently used in turning several hundred machine-steel rings shown at Fig. 1. A 16-inch scroll chuck was laid flat on the bed of a lathe convenient to the headstock. Fig. 2, *A*, was lightly driven in the center hole of the chuck and clamped to the lathe bed with the bolt and clamp shown.

One of the rings was clamped in the scroll chuck. The spider, Fig. 3, being placed on Fig. 2 at *B*, and the three screws in Fig. 3 tightened, making the ring practically true with the hole in Fig. 3. The ring and spider were then passed over the nut *C* and on to the fixture Fig. 4. The nut must be smaller than the diameter of the mandrel to allow the spider to pass over it. The slip washer *D* was then put in place and clamped with *C*. The turning and facing were done with two tools in separate tool posts, in such positions as to allow them to face both sides of

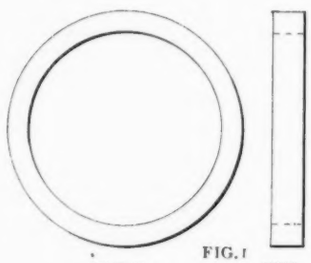


FIG. 1

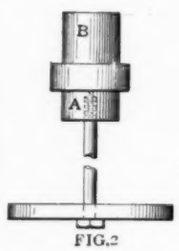


FIG. 2

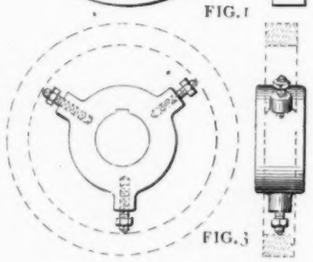


FIG. 3

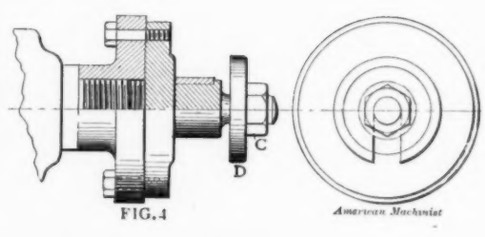


FIG. 4
American Machinist

A RIG FOR TURNING MACHINE-STEEL RINGS.

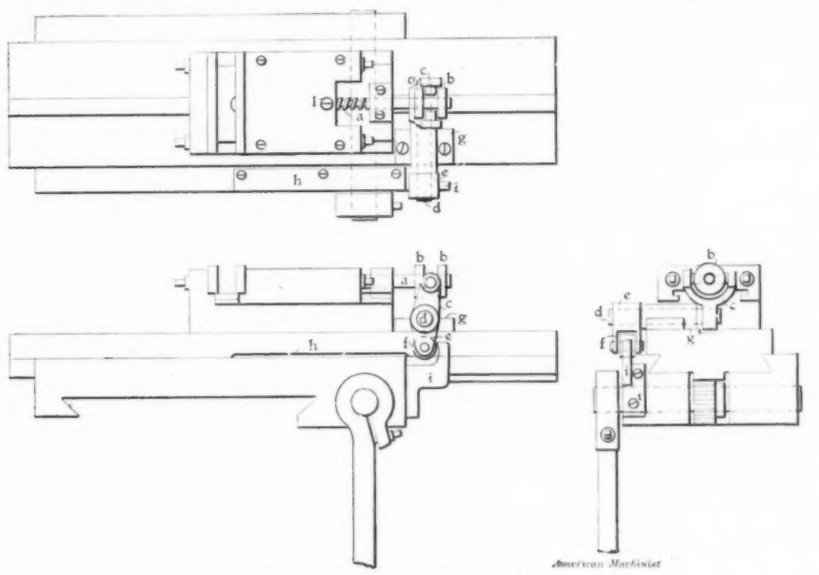
the rings simultaneously, either one of the tools being used for turning the outside. After being turned, the rings were clamped in a chuck and bored. They were then placed in an oven and evenly heated to relieve the strains. They were finally returned to the lathe and finished to size in practically the same manner as the roughing operations, with the exception of the boring, which is done while the work is clamped in a split chuck. G. HUBER.

The Crankshaft Lathe.

It is said that "the way to invent is to keep *thinking*." About three years ago I had a job turning up a couple of crankshafts by the old method. I began *thinking* out a better way to do that class of work, and the crankshaft lathe shown at page 468 was the result. I had never seen nor heard of the Tindel-Albrecht or any other crankshaft lathe. I have not applied for a patent, am not building crankshaft or any other lathes; hence there is no infringement so far as I am concerned. W. DE SANNO.

An Automatic Milling Vise.

In the automatic vise for hand miller shown, an ordinary milling vise was used; the regular closing screw being removed and screw *a* being substituted, the plain portion of which is a sliding fit in the housing, and having on its outer end the two fixed collars *b b*. Between these two collars the fingers of the yoke *c* operate; it is secured to one end of the rock-shaft *d*, on the other end of which is fixed the rocker-arm *e* carrying the roller *f*. The casting *g* is bolted to the table of the milling machine, and is bored out to receive the rock-shaft *d*. The hardened steel plate *h* is secured to the saddle, as is also the knock-off or trip *i*.



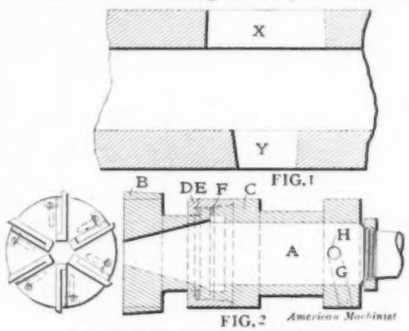
AN AUTOMATIC MILLING VISE.

In operation, when the table is fed forward, the roller *f* rides up on the plate *h*, being forced to the rear at the same time, thus rotating shaft *d* and yoke *c*, moving *a* forward and closing the vise. On the return movement the vise is opened by the roller striking the trip *i*.

Adjustment of the vise to suit various jobs is effected by the screw *a*, while the latter is kept from turning during operation by the set-screw *I*. C. W. PITMAN.

A Collapsible Reamer.

The accompanying sketches show a collapsing reamer used in a vertical milling machine for finishing the taper hole *X*, Fig. 1, in a fuel economizer which we are building.



THE WORK AND THE REAMER.

The construction may be readily seen by referring to Fig. 2. It consists of a machine-steel body *A*—in which are cut six tapering slots for the flutes *B*—which is connected to the sleeve *C* by the cap *D*. *E* and *F* are hardened and ground steel washers for minimizing wear.

By means of the eccentric slot *G* and the pin *H*, moving the sleeve *C* 120 degrees, gives a vertical movement of ½ inch in the flutes, with an expansion or contraction of ¼ inch. The flutes are of high-speed steel and are held in place by gibs and gib-screws, thus providing means for taking up wear.

The slots are cut on a very sharp taper, for the double purpose of having ample bearing surface for the flutes, and also to lessen the movement of the sleeve *C* in adjusting the blades.

The method of using the reamer is as follows: The hole *Y*, Fig. 1, is first finished by a cutter which also roughs out *X*, which is larger on the inside end. The reamer is then collapsed, and put through *X*; it is then expanded, and the hole finished by feeding the reamer upward.

This tool has been a complete success, both as to durability and as a time saver. It has cut down the time over 50 per cent. and has been working on an average of 20 hours a day for the last four months, reaming an average of 140 holes a day.

W. WESTON.

A Peculiar Break of a Bar of Steel —Washing the Hands With Cyanide.

The experience of J. P. Brophy at page 415, relative to the peculiar breaking of a bar of steel, reminds me of a similar occurrence which I will describe, but do not offer as an explanation of his case.

Desiring to cut off a piece from a bar—which to all appearances was cold-rolled stock—I chucked one end, set the steady rest for other end and started to cut off a piece about 2 inches in length. The bar was about 2¼ inches diameter and the parting tool about 3-16 inch thick. I was using a moderate speed and feeding by hand. When the tool had reached a depth of about 3/8-inch the end dropped off. To say that I was astonished puts it lightly. A second look assured me that the piece of steel was actually lying there, although it seemed hard to believe.

Examination did not reveal any sign of a previous break, but the broken section was very coarse grained. The part through which the tool had cut, worked like mild steel.

The superintendent, when shown the steel, expressed great amazement and could scarcely believe that it had happened as described, so at his suggestion I began another cut, first calipering the size at which the first piece had broken and being careful not to run the second cut any deeper than the first. We arrived at this depth safely, but a slight tap with a wrench caused the second piece to drop and things began to look bad for the purchasing agent.

Closer examination revealed the fact that it was a short piece of line shaft which I was working upon, and we began to wonder how soon the shafting would decide to disintegrate and descend upon us. We were soon assured, however, that line shafting was made that way purposely, in order to stiffen it and that the outer soft shell was sufficiently tenacious to prevent the shaft breaking, while the hard core added stiffness.

Not being conversant with the making of line shafting, I would be pleased to

have you present an outline of the process whereby steel is made in the above manner.

Apropos of the recent discussion of hand washing recipes, I was much surprised recently when entering a shop in which the operators encounter large quantities of brass dust and oil, to find that all hands were using a large lump of cyanide of potassium instead of soap for the roughing cut, and was informed that such was common practice.

It may be known to the majority of machinists that cyanide is good to remove dirt, but I had always had a feeling of respect for the substance, supposing so poisonous an article unsafe to become familiar with. RAYMOND GRANT.

Drill-Press Speeds in Geometrical Progression.

I was interested in the description of the new Bickford radial drill at page 360, and it struck me that this description conveyed the impression that a geometric series of speeds was not entirely suitable for a machine of this kind, and at all events not so good as the list given in the table. Now if the list of drills given in the table in that article are to be used all the time and if the "in-between sizes" are never to be used, then I can see where their method of arranging the speeds is rational, but since all sizes of drills are used on a machine of this kind I believe the geometric series covers the ground as well if not better than the method shown.

It probably makes little difference how we arrange the twelve speeds, for the reason that they will give us only twelve diameters which are just suited and several hundred which are not, and when we are using any one of these several hundred we are either burning our money on account of too slow a speed or burning our drill on account of too high a speed. I realize that it is absurd to arbitrarily fix certain diameters of drills to be used and then arrange the speeds in geometric series and expect them to be correct, but suppose we take it the other way.

I have made a table with the first column "Geometric series" taken from the first column of Table 2 and the fourth column "No. of feet at which drilling should be done," taken from the last column of Table 1 of the description referred to. The middle columns give the drills best suited for the speeds given. By referring to this table it will be seen that a geometric series gives us twelve sizes of drills, which my experience tells me are more often used than those whose diameters are in even eighths and quarters.

None of the drills shown in the Bickford table can be used when it is necessary to rosebit or ream a hole of that size, yet a great number of reamed holes are in these sizes, and there are only two sizes of drills given in the table whose diameters are suitable for full thread when using United States standard taps, viz., 5/8-inch for 3/4 tap and 1 1/2-inch for 1 3/4 tap.

The drills shown in the table herewith are in most cases enough below standard sizes to allow for rose-reaming, and strike me as being just as suitable as any others since we can have only twelve which are exactly correct. ART ISAN.

Geometrical Series	Actual size of drill	Approximate size of drill	Number of feet per minute at which drilling should be done.
265.09	.5	1/2	35.
221.90	.59	19/32	34.3
185.81	.69	11/16	33.6
155.54	.807	13/16	32.9
130.26	.944	15/16	32.2
109.04	1.103	1 3/64	31.5
91.31	1.288	1 9/32	30.8
76.43	1.469	1 15/32	29.4
64.	1.67	1 43/64	28.
53.6	1.895	1 29/32	26.6
44.85	2.145	2 5/32	25.2
37.56	2.5	2 1/2	23.8

TABLE SHOWING DRILL SIZES AND SPEEDS IN GEOMETRICAL PROGRESSION.

A High-Speed Steel Reamer.

In our shop we make quite a number of steel bushings, 1 27-32 inches diameter, 1 9-32 inches bore, 5 inches long. While absolute accuracy is not required, the holes must be true to size and smooth enough to make a good running bearing. We had been reaming these holes with a shell reamer, the outside being turned simultaneously, after which the bushing was cut off. This operation was carried on under a flood of oil. We were not getting very satisfactory results, as the reamer would not stand the speed that the turning tool would; so we constructed the reamer shown at Fig. 1. With this reamer we were enabled to almost double the speed. The body *B* is of tool steel hardened. Fig. 2 shows an end view. The slots *C C C* were milled to fit standard tool-holder, high-speed steel, the cap *H* being milled the same. The flutes *D D D* provide room for the chips. Setting the tools *G G* as shown gives the necessary rake for the satisfactory working of cold drawn tubing. Before setting the tools, I grind the tools to the necessary end clearance, and also give them a side rake, which throws the chips back in form of long, curled shavings. After assembling, the tool is ground to size. When necessary to regrind, the tools are shimmed up (where the end touches the next tool) and ground to size as before, the cap-screw *F* being provided with a center for that purpose. W. T. H.

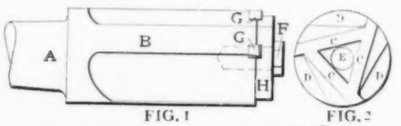


FIG. 1 FIG. 2

American Machinist

A HIGH-SPEED STEEL REAMER.

Loose-Leaf Books for Notes.

At page 472 you and A. D. Williams, Jr., each mention "S. & T." loose-leaf books as though all knew the meaning of the letters, but it seems such is not the case, as a house in Chicago to which I usually send for such things failed to supply me. The house asked me for the full firm name; I am asking you the same.

WM. S. ROWELL.

[Sieber & Trussel Manufacturing Company, 4000-4006 Laclede avenue, St. Louis, Mo.—Ed.]

Machining Large Segments in a 34-Inch Lathe—Another Large Lathe Job.

At page 504 I notice an account by E. Cooper Wills, of a 9-foot job done in a 34-inch lathe, which puts me in mind of a somewhat similar case of my own, back in a little shop in the Province of Quebec, not far from the city of that name. I happened to strike the place through a babbitt metal agent, who told me they could take on a man or two. As I was just out of my time, I thought it would be a good place to try as a feeler, to see if I did know anything about the business. I got work all right, though part of it consisted in trying to understand what was wanted, as everyone in the shop—and town—down from the foreman (who was manager, buyer, paymaster, shipping department and anything else that was needed to carry on the business) was French. The business was a general repair one for sawmills and farmers within a radius of fifty miles. I had been running a wonderfully constructed screw-drive 6-foot planer about a week, when I heard the glad sound of a voice using the English language, in a vain effort to make Pierre, the foreman, understand what was wanted. I was called over to help, and soon had the facts. The gentleman was a mill owner, and he wanted a 12-foot pulley in a hurry, and came to see if we could turn it for him. The biggest thing we had was an old antediluvian "gap" face-plate lathe, 72 inches swing (*le taureau*, the bull, the boys called it), down in the basement. I suggested that the headstock be blocked up to the right height and the job done that way. Pierre did not think it could be done; but he said (paftly with his hands), if I would undertake it, he would be only too glad to let me try; so we sent Mr. Millowner away to hurry up the casting, which was being made at a foundry thirty miles away.

A few measurements showed that part of the floor above must come out, and the countershaft be moved 2 feet back. This was done; the headstock raised about 40 inches, blocked and bolted. Then we threw off the carriage, which generally carried the boring tool, and in place raised the movable tool-slide and bolted it to the ways, which were capable of a 6-foot gap; however, we used only 2 1/2 feet, as the face of the pulley was 24 inches and the hub 20 inches. When it arrived I bolted it to the face-plate on wooden blocks. Then the joy began. To make the old spindle

turn over at anything like boring speed, I had an idler riding on the driving belt, with almost every old piece of iron in the shop hanging to it, and I spent all the time it was going cutting new belt laces off the edge of a cow-hide. After some rather tall hand-feeding, I got a fairly straight hole. I took down the tool-rest, or slide, and blocked the tailstock up in its place, after inserting a short gray-iron mandrel. Then I blocked the same slide-rest up to center-lever at the rim, and started it at about 18 feet per. With the triple gears in and the whole shop running half speed (water power), she went O. K. Three nights and two days finished the job, and I heard afterward that it did not run over 1-32 out; but to this day I am a little skeptical as to the size of that 1-32 inch. I left soon afterward, the standard scale of wages—17½ cents per hour—not reaching my highest ambition; but I will always remember with pleasure my short sojourn in that shop. W. L. McL.

Making Corrugated Copper Gaskets.

Corrugated copper gaskets are used in enormous quantities in the navy for joints of all sorts. The demand for these gaskets has been so great lately that a corrugating machine was designed at the Brooklyn navy yard; one machine has been built and several more are in course of construction. Figs. 1 and 2 show the whole corrugated-gasket plant, with the exception of an ordinary squaring shear.

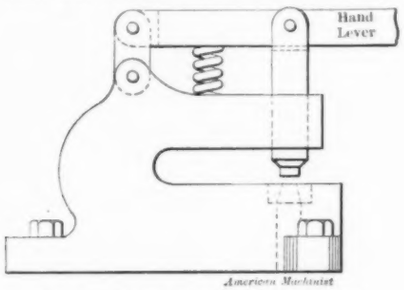


FIG. 1. HAND PUNCH FOR GASKETS.

The sheet copper is first cut to approximate size in a shear, a 5/8-inch hole is then punched in the center by the hand punch shown at Fig. 1. The piece is then transferred to the standard *A* (see Fig. 2), being held in position—on a pivot mounted in the end of *A*—by the thumbscrew *O*. The standard *A* is mounted on a base which slides on the bed *B* and can be clamped in any position by the handle *D*. The upper rotary shear *E* is fed down—by the screw *F* while the handle *G* is turned with the left hand—shearing the copper disk to size.

After the required number of disks are brought to size, the standard *A* is moved along the head until the disk *P* is in correct relation to the corrugating rolls *I*. The spindle of the lower corrugating roll *I* is in fixed bearings, but the bearings of the upper corrugating roll permit it to be raised or lowered by the screw *J*. The corrugating machine *H* is belt driven and the machine is started up with the copper disk between the rolls *I*, the top roll being gradually lowered until the gasket is finished as far as the corrugating is concerned. It will be noticed that on the end of the spindle, carrying the lower corrugating roll, there is mounted a slitting disk *K*, and that there is a bracket *N* bolted on the frame of *H*. The bracket *N* carries a slide, operated by the screw *M*, to which is attached the slitting disk *L*. When the corrugating is finished the disk *L* is brought down, cutting the center out of the gasket. The piece so cut, if large enough, may be used for smaller gaskets. A number of sheet steel templets, having the bolt holes properly located in them, are also part of the equipment at the navy yard. The gasket is fastened to its templet, and the bolt holes are punched in it by the hand punch, Fig. 1. I saw a 6-inch gasket made complete from the rough sheared stock in less than half a minute, including the time necessary to make all settings of the machine. DIXIE.

Factors of Pi.

At page 570, Mr. Cox challenges the accuracy of my figures in reference to the difference between $\frac{355}{113}$ and π.

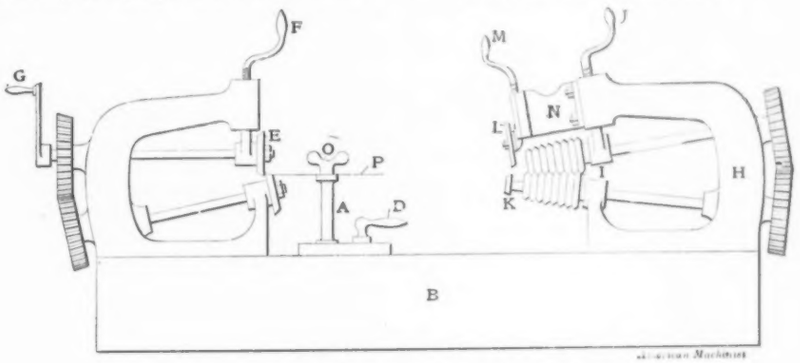


FIG. 2. CIRCULAR SHEAR AND CORRUGATING MACHINE.

From Mr. Cox's statement, it is apparent that he is mixing the absolute error with the relative error. There is always a doubt as to exactly what is meant when an error is expressed as a difference of length, or in similar terms; and in noting Mr. Cox's original article, this doubt entered my mind; but upon subtracting 3.1515928, the figures said to represent π in that article, from 3.1415929, the decimal value of $\frac{355}{113}$ I found that the absolute error was .0000001; by converting this to the fractional form, it equaled $\frac{1}{10,000,000}$ which equals, approximately, 1 inch in 150 miles. This agreed with Mr. Cox's figures, and therefore I assumed he was speaking of the absolute error. The editor was also led to the same conclusion, as shown by his footnote at page 362.

I again state that the absolute or actual difference between 3.1415929 and 3.14159265 is .00000025, which, converted into its fractional form, equals $\frac{25}{100,000,000}$ or $\frac{1}{4,000,000}$ and this expressed in length, equals 1 inch in 63 miles.

GEO. P. PEARCE.

[We think the positions of both parties are now fully understood, and that enough has been said.—ED.]

Experiences in Marketing Gap Lathes.

A good many years ago quite a discussion was held in these columns as to the relative merits of gap lathes and standard straight-bed lathes. The opponents of gap lathes maintained that beside such a lathe being of no value, there would be no sale for it. None of the writers had ever tried to sell such a tool, so it was all in the air. The discussion related, as I remember it, entirely to the gap lathe with a removable block, not to the sliding bed lathe. The men who took part in this discussion are probably all still reading the AMERICAN MACHINIST, so they may be interested to know that the experiment has been tried, and how it came out.

About five or ten years after this discussion I was in charge of a machine-tool plant, and we were receiving occasional inquiries for gap lathes from abroad. We paid no attention to them until one came from our Russian agent. We were doing a good business through him and had every reason to wish to please him, and as his order promised to be a good one, we built him a sample lathe, using every possible part of the standard tool. We had to make the carriages and aprons one-sided, but we used the same details of both. We also had to get the lead screw around the gap. The way we got the bed castings without much change in the bed patterns has already been reported in these columns. Well, we got out these sample lathes and a few more for this agent—perhaps a dozen in all. He said they were all right, just what his customers wanted; but he stopped ordering. Then we thought we would see what we could do with them, and sent out circulars to all our custom-

ers at home and abroad. These brought in a good bunch of inquiries from all directions, which we were able to turn into orders at the rate of about one a week. As the orders were almost wholly for 20- and 24-inch sizes, this was all that we could handle with our regular trade. The surprising thing was that the orders came almost equally from at home and Europe and other parts of the world. Whenever we had an inquiry for a lathe of over 24-inch swing, we sent, with our reply, circulars of gap lathes, and often they brought us orders where we were perfectly certain that otherwise the order would have gone to a competitor. One order I recall now as the most peculiar experience that has come my way. We had an inquiry from a textile mill, and I went over to see the proprietor, and gave him prices, etc. He remarked that if he could buy a gap lathe for so much less than he expected to put into a 36-inch lathe, possibly he could afford a small lathe for the toolroom, on which I also made a price. After quite a little talk, which I thought ought to lead up to his ordering, I left. It never was my practice to hang on too long the first time I saw a man, especially around here where things are usually well thought over before decisive action is taken, so I didn't directly ask for the order then. What was my surprise, a week later, to receive a letter asking that we fit certain size chucks to the two lathes "which he had ordered." We rushed them out in a hurry; but it was the only time I ever sold a bill and didn't know it.

But to get back to gap lathes: We sold quite a number—something over a hundred in all—and if the eating has anything to do with the proof of the pudding, a gap lathe is a good thing in many places. We put two of them in government shops, some in mill repair shops, some in manufacturing establishments for special purposes, and some on board ships for repair work. We built up such a nice little business that we were afraid to advertise in the papers, for fear that everyone else would crowd in, and there was really not business enough to go around and give everyone a share; but by quietly and persistently writing and sending circulars we managed to pick out our orders without very many people hearing of it.

E. H. FISH.

Machine Filing Versus Hand Filing For Band-Saws.

In reply to the article by "Capitalist," at page 255, in which he states in regard to machine-filed saws, that their work is not always regular, I wish to state that I have also had some practical experience along this line, which seems to contradict "Capitalist's" argument. In one of the largest saw-manufacturing establishments in the country, where five or six hundred men are employed, filing machines are used for a great portion of the work, not only for band-saws, but also for hand-saws. When I was at this factory there were at least three machines working on hand-saws, each machine capable of working on three saws at a time; and there were at least two machines working on band-saws. These people have been in business a great many years and use these machines because they are money savers to them. And I personally know of and have used one form of band-saw filing machine, using a rotary file, which has been on the market three or four years, and which has given entire satisfaction.

JUSTICE.

Collodion for Restoring the Surface of Tracing Cloth—and Another Method of Accomplishing the Same Object.

At page 397 Paul W. Riedel tells of using collodion on tracing cloth after erasing ink lines. Several years ago we used collodion for this purpose, but soon discontinued it and adopted a simpler method. We use erasers entirely. The ink is started with a Faber's "typewriter eraser," and the erasing is finished with a Faber's "211 emerald eraser." Then with a piece of clean cloth over the finger the tracing cloth is gently polished. The cloth must be lightly rubbed on a piece of common chalk. A bit of clean, white cotton waste wadded hard will answer as well.

I have erased lines and figures and restored the gloss again, as many as six times, without wearing a hole in the tracing. The erased spot, after the "chalk polishing," will not gather dirt, and it is almost impossible to discover where the erasure has been made, except by looking through the tracing. I have never, as yet, found a way to eliminate the opaque impressions in the texture of the tracing cloth, made by the lines, figures, titles, etc., which have been erased.

Too much chalk, too vigorous polishing at the start, or a too free use of the "typewriter eraser" will leave the surface of the tracing cloth gritty. *Never,* under any circumstances, touch a knife or a scraper to tracing cloth, for, no matter how carefully used, such instruments will destroy the surface.

We are frequently called upon to make details on tracing cloth, or a construction tracing must be "filled in." We proceed as if using paper. The lines are drawn in with a sharp *soft* pencil and then inked over. The tracing is then washed with a clean piece of cotton waste wet with gasolene, which thoroughly removes all pencil marks much quicker and better than a rubber, and leaves the tracing cloth clean and bright, without in the least impairing its gloss or injuring the ink. Old tracings that have become soiled may easily and quickly be made to look like new by this treatment. Red or blue pencil marks, or the soft pencil "blacking out" on the back of a tracing, may be instantly removed with the gasolene swab.

As to which side of the cloth to use, much depends on what the tracing is to used for. Ordinarily we prefer the gloss side, although the dull side takes pencil lines better and does not require so much "chalk polishing" after erasing. If the tracing is to be photographed we invariably use the dull side.

Whichever side we use, we prepare it for the ink by lightly rubbing the surface with a piece of cotton waste dipped in chalk dust. Some draftsmen prefer "fuller's earth," but my experience has demonstrated to me that chalk is the better.

F. J. P.

From Puget Sound to the Orient—An Engineer's Experiences.

Several years ago I was third engineer of a tramp steamer of about 4,500 tons, with triple-expansion engines of 2,000 indicated horse-power. The condenser, air pump and circulating pumps were at the back of the engines, operated by working levers from the low-pressure crosshead. We were chartered to take a cargo of flour and timber from Tacoma to Vladivostok, Port Arthur and Dalny. After three weeks steaming at a steady 10-knot gait, we arrived at Mororan, in the island of Yesso, close to the Hakodate naval station, Japan. After refilling our bunkers there, we went north to Vladivostok, where we discharged part of our cargo and proceeded to Dalny. The captain was dubious about entering the latter port, as the place was not properly charted, and the pilots there were somewhat of the same type as the old Scotch fisherman who was engaged to pilot a yacht among the Scottish Western Isles. When asked by the owner if he knew all the rocks in the vicinity, he answered, "Ay, ah ken them a' "—"an' that's one o' them," as the yacht shuddered and lurched to one side. After we had entered the harbor, and the skipper had selected what he thought would be a good anchorage, he backed the engines while lowering the cable, and in doing this the ship ran across some rocks and damaged fourteen plates in the double bottom, so that she commenced to leak badly. We kept the pumps working in the leaky section, got logs, sacks and several tons of cement from the shore, with which we filled up the double bottom solid in the vicinity of the damage and made the ship nearly watertight thereby. After discharging our cargo at Dalny, we proceeded to Port Arthur, and while lying in the harbor there we discovered that one of our four propeller blades was broken short off close to the hub; so we determined to replace it with a spare one, which we had in one of the holds.

We rigged up a raft and tried to "tip" the ship up at the stern by filling the forward tanks and pumping out the after

ones; but in this we were unsuccessful; so we flooded the forward hold, and even this only raised the hub of the propeller three inches above the water; this was, however, high enough for our purpose. At 6 A. M. next day we started in to remove the nuts from the studs securing the base of the broken blade to the hub. One of the studs was broken, but we managed to get it out of the hub with the aid of a calking tool and heavy reamer. It was no pleasant task, as the temperature was below zero and the water washed continually over the raft. I might mention that the big ice-breaker was at work in Vladivostok harbor at the time, but we had the new blade in place, nuts tightened and all cemented over at 4 P. M. the same day.

Quick work! but we had to work hard to keep warm, though the warmth was partly produced by the contents of a gallon jar which the skipper brought aboard for us. We left Port Arthur next morning

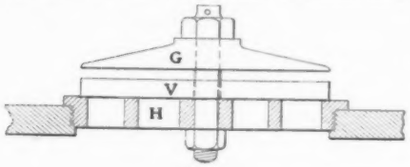


FIG. 1

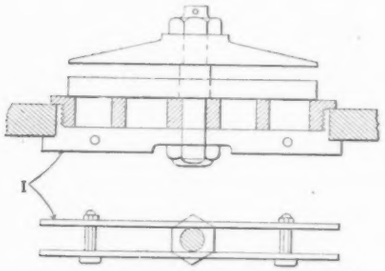


FIG. 2 *American Machinist*

THE REPAIR OF THE VALVE.

for Mororan to load coal for Singapore. We had lain in Mororan about fourteen days, and taken advantage of the time at anchor to thoroughly overhaul the engines and boilers. Just when we had the machinery all apart, a storm rose and the sea became very rough, causing the ship, which was very light and thereby exposing a great surface to the wind, to strain heavily at her anchors. While we were in this condition a Japanese bark came in and anchored between our ship and the shore and right in our path if the ship should drag her anchors. There was every chance of this occurring, as we were anchored on a sand bottom. Our captain signalled to the Japs to shift their anchorage, but they did not take any notice of our signals, about 10 P. M. we began to drift down on them. The Japs now saw their danger, and began with frantic haste to pay out their cables until they were all out and they could do nothing further to save their ship. Shortly afterward the two ships came together and carried away the Jap's foremast and yards and our topmast. The Japs all scrambled on board our ship and would not go back; so our chief engineer and second mate jumped on board the bark with the intention of securing her to our ship with ropes, so as to prevent further damage; but they failed in this, as the ship yawed apart almost immediately. In the meantime we were letting out our cable as rapidly as possible, so as to get astern and clear of the bark. In this we were successful, but the next plunge the bark took she went right over our cables, and whenever our ship dragged on them the bark was almost lifted out of the water. Finally we got clear of each other, and our cables held when we were only about 200 yards off the beach.

Next morning the storm abated, sampans came off and took the Japs back to the bark and returned with our two officers, who were cold and hungry, as the only sustenance they could find on the bark was a bottle of "samshu" (native whisky), which they confiscated, consumed and felt comforted thereby. In the afternoon a police boat came off to us and took the skipper ashore to the court to show why he should not pay a claim of several thousand yen to the owners of the bark as a result of the previous night's damage. The captain consulted the steamship's agents and the consul, and was privately advised by both to get to sea as soon and as quietly as possible.

We got the remainder of the coal on board while the engineers were "closing up" the engines and boilers and raising steam. One dark but clear morning we heaved anchor, and with no whistle blowing nor pilot on board, we slipped through the straits past the Japanese naval station and laid our course for the open sea. Early in the forenoon the vacuum fell several inches, and a rattling sound in the circulating pump warned us that something was wrong in that direction. We were very chary of stopping, but decided that to be the best course of procedure, "lest worst befal us." We took the doors off the circulating pump and found that two valve seats had carried away. These were circular brass gratings, screwed into the gray-iron frame of the pump. The threaded part of the frame had corroded away and allowed the seats to get loose. We decided to make a couple of clamps to hold them, and as there was no material in the engine-room, we took one of the bars from the hatches—which are used for securing the canvas covers to them—and cut off four pieces, each about 1 inch longer than the diameter of the seats. We then punched two holes, 3/8 inch in diameter, through each of them, and cut four pieces of 1/2-inch pipe, 1 1/2 inches long, which we placed between the bars and over the holes, and passed 3/8-inch bolts through them, the whole forming two clamps, one of which we placed under each seat. Then we removed the deep lock nuts from the lower end of the studs, which passed through the center of each seat and valve, and to which the valve guards were secured. We reduced the deep lock nuts on these studs one-half in thickness. The clamps were placed under the seats, and the center studs projected through them. We screwed the reduced nuts under the clamps and riveted the ends of the studs over them. We boxed up the pump and got the engines under way again after a stoppage of about one and one-half hours.

Shortly afterward, when we were several miles from the coast, a cloud of smoke appeared on the horizon behind us, and the tiny dot from which it arose speedily resolved itself into a torpedo destroyer coming full speed toward us in a smother of foam. We all felt pretty sick, and had visions of durance vile in a Japanese prison, with rice as a staple diet, as the laws which we had infringed were many; but to our surprise the destroyer merely steamed up slowly alongside, and after scanning the ship closely she crossed our bows and headed back for Hakodate, her mission evidently having been to identify us. We naturally expected to have further visitants with the "Rising Sun" flag floating over them, and the ease with which we had been overtaken convinced us that we had no chance of escape if they desired to detain us; but we saw nothing further of them, and eighteen days later we arived at Singapore, with the northwest monsoons driving behind us, and there we went into the graving dock, where we had the bottom patched up for our long run to the Pacific coast.

Fig. 1 shows one of the valves of the circulating pump, *V* being the valve, *G* the guard, *H* the grating. Fig. 2 shows the repair made, *I* being the clamp.

H. J. T.

How to Lift Heavy Vises Easily.

We all know how mean a job it is to lift heavy machine vises off and on to the tables of shapers, etc., owing to the difficulty of getting a good hold. I find it comparatively easy to handle them by gripping a piece of 2x4 scantling in the jaws good and tight with, say, about 15 inches projecting outside the jaws on both sides. This makes an excellent handle, which facilitates handling either by one person or two. HARRY ASH.

A Large Gear-Wheel.

The article at page 534, referring to a large gear 18 feet in diameter, being cut by R. D. Nuttall, reminds me of a large gear that was made by the West Point Foundry, at Cold Spring, N. Y., for the Calumet & Hecla Mining Company, in about 1888. The wheel, or rather rim, for it had no spokes or hub, was made in segments and was 54 feet pitch diameter, 4.71-inch pitch, 432 teeth and 18-inch face. It was for the purpose of driving what was called a sand wheel, being bolted to the outside of this wheel. Though the

teeth were cast, it was literally a cut gear, as there was ¼ inch allowed all around the teeth for finishing. This could not be done at the West Point Foundry, so the wheel was set up at the mines and there the teeth were machined.

SCRIBE.

Brazing Gray Iron.

At page 607 you ask for a method of brazing gray iron. Gray iron can be brazed with common brass and borax, heating the piece sufficiently to melt the brass.

G. H. N.

A Fiber-Washer Cutter.

The fiber washers we had been getting from the press shop had not been giving satisfaction, owing to the fiber not standing up to the punch, and so giving a rounded instead of the clean-cut edge we needed. To obviate this, we tried several different clearances in the die, but without success, and finally decided to cut them out with a tool in an ordinary sensitive drill press. As the result was highly satisfactory, both for speed of production—as we were able to cut several sheets of fiber at once—and for the quality of the washers produced, I will describe the tool in detail.

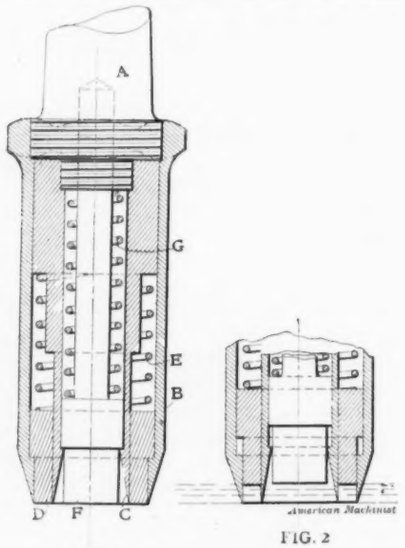


FIG. 1 FIG. 2

A FIBER-WASHER CUTTER.

Taking an ordinary machine-steel arbor *A* in Fig. 1, we threaded the end as shown. To this we fitted the hardened and ground tool-steel outer cutter *B*. Between *B* and the inner cutter *C* was the machine-steel case-hardened pressure ring *D*, free to slide against the downward pressure of spring *E*. Sliding in *C*, and controlled by a hole in *A*, was the central pressure piece *F*; this also was free to slide against the downward spring pressure of G. The pressure pieces *D* and *F*, in addition to steadying the fiber while being cut, ejected the washers from the tool. Fig. 2 shows the cutter at work in a piece of fiber.

C. F. H.

A Sound-Deadening Anvil Block.

The accompanying drawing shows an anvil block, designed by Professor Wiliam H. Odenatt, director of the department of mechanical engineering, for use in the smithing department of the new Northeast Manual Training School of Philadelphia.

In equipping the forge room of the new school, it was desired to do away with the unsightly wooden block which is in use in so many places, and at the same time use some means of deadening the sound, because when fifty anvils are being used at a time in one room the noise, when iron anvil blocks are used, is almost deafening, and not only affects the instruction in that department, but creates a disturbance throughout the whole building.

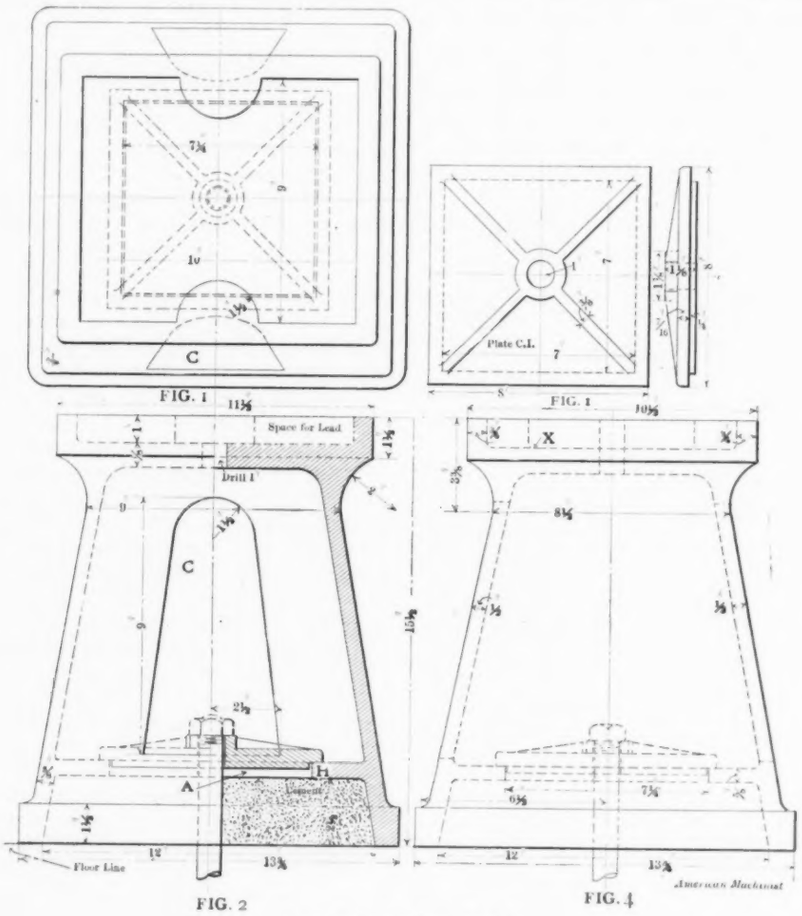


FIG. 1 FIG. 3 FIG. 2 FIG. 4

A GRAY-IRON ANVIL BLOCK.

On looking at the drawing, one can readily see the steps taken to overcome the bad feature of a metal anvil block—that is, by the use of lead.

In setting up the block, a hole was dug and a foundation of cement, shaped like a frustrum of a square pyramid, 18 inches between bases, was buried to the depth of 16 inches, leaving 2 inches above the surface. This foundation, which was made in a mold, is of such size that the anvil block could easily fit over the smaller base, and as shown in the sketches, has a long bolt, ⅞ inch diameter, 12 inches long, extending above the center about 2 inches. The anvil block was next placed in position over the foundation and leveled, when more cement was poured in through the opening *A* until the chamber in the bottom of the block was completely filled and a solid bearing made on the wall *H*, after which the gray-iron plate shown in Fig. 3 was placed in position by turning it on edge and slipping it through the opening *C*. By placing a nut on the ⅞-inch bolt, the plate was drawn down, making the block very rigid.

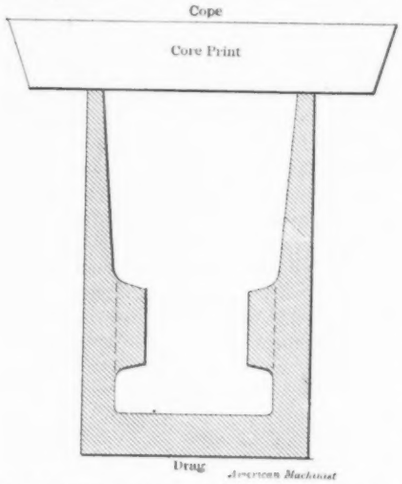
The anvil—tapped ⅞ inch in the center of its base—was set in place over the part of the block marked "space for lead," being raised from the surface shown by line *X* in Fig. 4 by ½-inch blocks placed under the edge of the base. After tightening the anvil to the blocks by a ⅞-inch cap-screw, they were slightly heated to prevent chilling, and lead was poured around the anvil until the space for it was filled, thus burying the anvil to the depth of ½ inch, as well as allowing ½ inch of lead between the bases and the anvil block.

We have forty-eight anvils set up in this manner, and are highly pleased with them, as it is now easily possible to carry on a conversation in an ordinary tone of voice when all are being used.

FRED. S. CRISPIN.

Three Ways of Molding a Piston Head.

Referring to the article at page 536 on this subject, by Wilber, it is quite clear that the last method is the best of the three, but it, too, has a few points that can be improved on.



GAS-ENGINE PISTON, SHOWING CORE PRINT.

In Wilber's third method, the core has to be very strongly rodded to enable it to resist the upward pressure of the metal on the ends; the molder must exercise considerable care in setting his chaplets and in using the gage stick on the ends; and the cope sides of the castings may still have bad spots.

My method of molding does not require a strongly rodded core, or the use of chaplets, but permits of a flat cope being used and insures good, close iron on the closed end and around the rings.

As shown in the sketch, a solid pattern is turned up having a core print on one end. This print projects far enough all around to insure a good bearing for the core, and it also has considerable draft to allow of the core being centered easily.

The closed end of the piston is molded down, as shown, and the cope parts on the top of the print. The core-box is halved so as to bring the boss in the bottom of the box.

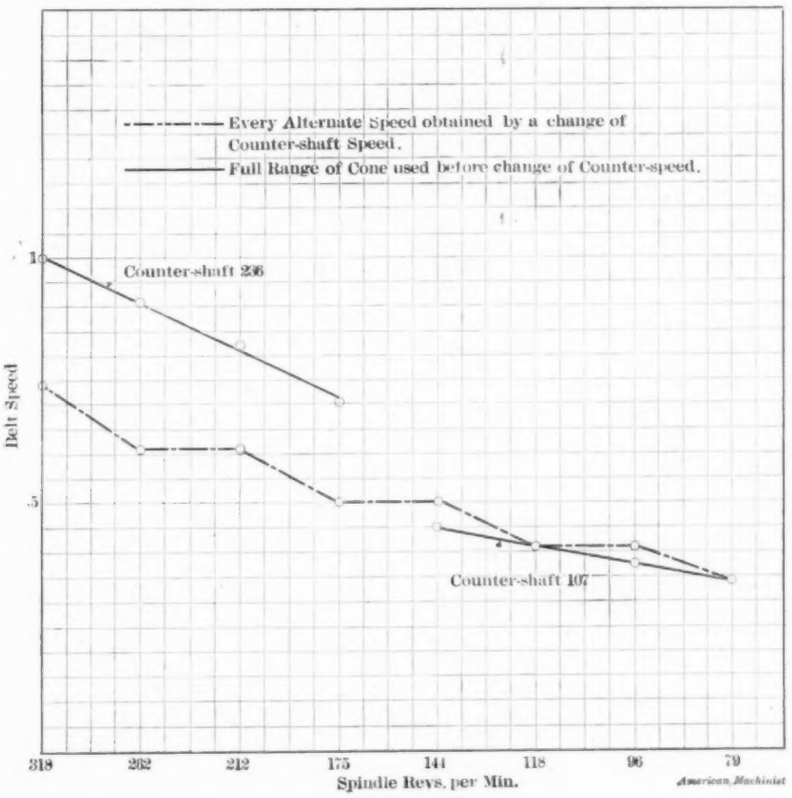
This method gives good results and may be followed for all sizes of this style of piston.

J. A. M.

Calculating Cone-Pulley Speeds.

I notice at page 432 that Mr. Owen, answering my letter on the layout of cone pulleys, says: "It is clear that by increasing the diameter of the small step, the slowest belt speed is also increased, thereby making the smallest horse-power supplied to the machine as great as possible." Does it? A moment's real reflection proves that it is not the case. The slowest spindle speed must be obtained while running on the largest diameter of the spindle cone. As this is the same by either method of layout it follows that the slowest belt speed is the same in both instances. The maximum belt velocity is greater, I grant, but the minimum is the same.

The relative belt velocities for both methods of layout may be interesting. They are indicated on the accompanying diagram which is worked out for the case written upon in the previous article.



SPEED DIAGRAM.

Referring again to the reason for more general use of this method: The fact of the flatter cone looking more powerful is a large factor in its general adoption. More tool design is done by appearance than by diagrams on squared paper.

H. T. Millar.

Manchester, England.

Escalators in a Factory.

The American Woolen Company, of Boston, Mass., through its president, William M. Wood, has signed a contract with the Otis Elevator Company, of New York, for four escalators to be installed in the new "Wood" worsted mill which is being built at Lawrence. This is the first factory installation of the escalator on record, and in fact one of the first instances where provision has been made in a factory equipment for mechanical means of elevating employees from the surface level to the various floors.

Although this escalator installation involves an investment of approximately $100,000, it is calculated by the management of the American Woolen Company that the enhanced efficiency of the employees will more than offset the interest on the investment, most of the employees being women.

To distribute without delay to their respective floors so formidable an army of workers as will be housed in the new "Wood" mill will, naturally, require a tremendous elevating capacity. It is estimated that 100 ordinary elevators would be required to equal the equipment represented by four escalators. The escalators will be run in a downward direction just prior to, and for a short time after the noon whistle, and in similar manner at the closing hour at night, also in the event of fire or other panic. At all other times they will be run in an upward direction. The feature of instant reversibility and the fact that the escalator acts as a constant carrier without attendance will insure in the event of serious panic the delivery to the street level of anyone who can reach or be helped to the escalator, even though such individual was unconscious during transit.

It should be interesting to calculate and observe what will be the actual result of an escalator installation of this magnitude in a factory of this character from a "social welfare" point of view.

Chemical Solder for Small Metal Articles.

Cut "pure" tinfoil in shape wanted; moisten on both sides with sal ammoniac. Have both sides to be soldered clean. Attach wet tinfoil to surface to be soldered. Press and bind parts together strongly with wire or otherwise. Heat till tinfoil is melted.

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Contents.

	PAGE
Making the Pattern and Mold for a Bed for a Power Press	657
Electrification of Ore-Carrying Road	659
A New Swiss Dynamometer	659
Milan International Exposition, 1906	660
Simple Steam Turbine Engines—II	660
Cement for Iron	663
Six-Spindle Special Driller	664
Pipe Flange Standards	665
Standard Cast Flanged Pipe Fittings	666
Short Cuts on the Slide Rule	666
The Féry Radiation Pyrometer	668
The Effect of Wide Tires on Traction	669
Letters to the Editor: Inventions and Patents....Lining a Marine Crosshead....A Tool for Numbering Negatives....An Electric Object Lesson....A Fish-Line Belt....In Re-Directors Who Do Not Direct....Economical Method of Molding Special Gears	670-683
Escalators in a Factory	683
Chemical Solder for Small Metal Articles	683
Higher Costs and Lower Prices	684
Standard Catalogues	685
Standard Hose Couplings	685
New Tools and Machine Shop Appliances	681
Enlargement of the Bertram Plant at Dundas, Ontario	689
Meeting of the American Society of Mechanical Engineers	689

Higher Costs and Lower Prices.

In our report of the recent meeting of the National Machine Tool Builders' Association in New York, we referred to a then probable advance in prices of certain machine tools, and said that this advance was "to help cover the increased cost of manufacture, due to improvements in construction."

It is probably a fact that only a few, even among those who are best informed in machine-tool matters, are aware of the extent to which improvements have gone on in certain lines of machine tools during recent years, without any, or at least any adequate, advance in prices to cover the increased cost. Indeed, in many cases this increased cost has been accompanied by an actual decrease of selling price. Manufacturers, in their natural desire to meet every requirement of customers, and in competition with one another, have gone on increasing the weights, the capacities and the conveniences of their machines, have designated them by the same numbers and sold them at the same, or at even lower prices, until in some cases this process has now gone to the point where a fair profit no longer remains for the builder, and something seems necessary to be done.

The AMERICAN MACHINIST, of course, does not stand solely for the maker of machine tools, but for the user of them as well. It aims to consider and to conserve the interests of those who are interested in machine tools, whether they produce or whether they buy and use them; but the present state of affairs seems to call for a frank statement, which we make as fairly and as impartially as may be.

We shall be best understood, perhaps, if we cite a concrete example, and as such we take the case of the product of a well-known builder of milling machines, and give herewith a table, giving the principal dimensions of a machine, designated by the builder as the "No. 2 Universal Miller," which is of the latest pattern. In parallel columns are given corresponding data of the old "No. 3 Universal," as built in 1897, and of the new "No. 3 Universal," as now built. A study of this table will be, we think, quite instructive. It brings out the fact, which we think will surprise many, that what is made and sold to-day as a "No. 2 Universal Milling Machine" is in every respect a larger, stronger and more productive machine than the "No. 3 Universal" of eight years ago. It weighs 130 pounds more. It has a positive feed, with a quick-change device, instead of the old, simply-constructed belt feed; a dividing head that is very much improved, being actually about twice as large and heavy as the one used on the older machine; and during re-designing the dimensions of the machine, as shown in the table, have been regularly increased, so that the No. 2 machine of to-day, as compared with the No. 3 of '97, has the same size driving cone, a wider back-gear ratio, nearly double the feed range, a larger table, and the same size of column.

	New No. 2 Univ. 1905	Old No. 3 Univ. 1897	New No. 3 Univ. 1905
Width of table	10"	9¼"	12"
Length of table	43¾"	46"	51"
Area of working surface	407½"	408½"	576"
Thickness of table	3¾"	3⅝"	4⅜"
Diam. of overarm	4¼" steel	4½" C. I.	4⅝" steel
Length of knee	21⅛"	21"	24⅛"
Depth of column	17⅝"	17¼"	18¼"
Width of column	8¾"	8¼"	8¾"
Diam. of largest cone step	11⅛"	11⅜"	12"
Diam. of smallest cone step	6⅛	6¼"	9¾"
Back gears	single	single	double
Width of belt	3"	3"	3½"
Feed changes	12—geared	12—belt	16—geared
Feed range	.005 to .253"	.006 to .150"	.006 to .300"
Net wt. about	2,930 lbs.	2,800 lbs.	4,200 lbs.
Price, selling	$675.00 2 power feeds	$850 00 2 power feeds	$975.00 3 power feeds

Besides these increased dimensions, the No. 2 machine of to-day has by actual count eighty-eight more parts than are found in the old No. 3, and many parts are so made as to be considerably more expensive. For instance, many of the gears, the trip dogs, levers, etc., that were formerly of gray iron, are now of steel or malleable iron; parts formerly made of unhardened steel are now hardened; the over-arm is now made of steel instead of gray iron, and many of the minor bearings, which formerly no one thought of bushing, are now bushed with bronze.

While we all know that the cost of producing certain machine parts has been considerably reduced within the period named, many of the most expensive operations that enter into the construction of such a machine have not been reduced in cost materially, if at all, and there has been a constantly increasing standard of accuracy demanded and maintained; this, of itself, tending to add considerably to the cost of the most expensive portions of the labor entering into machine construction. Now, instead of such a machine selling for more money, or even for the same price as the inferior machine of 1897 sold for, it actually has been selling at $175 less than the older and inferior machine, though costing much more, and being actually worth much more to the user.

A somewhat analogous thing has been done by builders of lathes, drill presses, planers, etc. A 14-inch lathe, for instance, means a very different machine, in most shops, from what a 14-inch lathe meant ten years ago. It is a much heavier machine, has features on it not thought of ten years ago; is in many cases cases expected to be, and actually is, much more accurately constructed, and yet it is sold at the same, or only a slightly increased price. Much the same may be said of planers. A 48-inch planer of to-day is a very different affair from a 48-inch planer of ten years ago. Much more metal is put

in around that 48-inch dimension, to say nothing of increased facilities which have been added from time to time, and which have increased the cost of manufacture, increased the usefulnes of the machine in proportion, and for which the builder receives no compensation whatever.

It is to be expected, of course, that as improvements in shop practice go on, buyers will be constantly able to get more for their money, but we are convinced that cost-increasing improvements have of late gone far ahead of cost-reducing methods of manufacture, and we find the anomalous condition that in these rush times, when many tool builders are unable to fill orders promptly and are running nights to keep up, some tools are actually selling so near cost as to leave an unsafe margin or none at all. True enough, the builders in most cases think they make it up on other machines, but that is not a good way to do business, nor fair to buyers generally.

Standard Catalogues.

We note the announcement that at the last meeting of the Southern Hardware Jobbers' Association, a committee was appointed to consider the matter of standard sizes for regular, bound and loose-leaf catalogues. This committee, consisting of J. E. Moore, Charles H. Ireland and D. D. Potter, reported that it had looked into the matter carefully and had made a careful canvass of the membership, and it recommended for regular printed and bound catalogues a standard size of 8¼x11 inches, and for loose-leaf binders a sheet 9½x11 inches.

It would seem as though, if this committee representing the Southern hardware jobbers had looked into the catalogue question even a little, they would have discovered that there has long been in use a series of standard catalogues, and that these sizes have received the endorsement of most of the technical societies and many trade associations; that they are recommended by the master mechanics, and the Master Car Builders' Association; that the publications of the American Society of Mechanical Engineers and other technical and professional societies conform to them; that among machinery builders the sizes prescribed by this standard series are adhered to in the majority of cases, and that their use is increasing all the while. It would seem, therefore, to be the height of folly for the Southern Hardware Jobbers' Association to adopt a series of standard catalogues differing in size from those that have already been adopted, and the practicability of which has been proven by long years of use.

The AMERICAN MACHINIST is itself the size of the largest standard catalogue. The next size smaller is 6x9 inches, and is the one mostly used by machinery builders. There is no reason that we can perceive why these two sizes of catalogues are not well adapted for use by the Southern or any other geographical division of the hardware jobbing trade. It would seem as though Newell Sanders, of Chattanooga, who many years ago first proposed in our columns that a standard catalogue should be adopted, and set forth the advantages of such a standard, should look after his compatriots and see that they do not go astray in this matter.

According to a recent decision in a police court in England, water for an automobile or traction engine may not be taken from a roadside trough, put up for the purpose of watering horses and where the water is supplied by the municipality. A man in charge of a traction engine took some of such water supplied for horses, and was let off easy for the first offense by being mulcted for the costs only, though it was intimated to him that in future such cases would be more severely dealt with. It seems, therefore, that in England, unless one can feel pretty sure of being able to obtain a supply of water from some wayside brook, or from a friendly householder, he must have a tender along, or at least something of sufficient capacity to carry a supply of water for his journey. We infer from the pleading of the defendant, in the case referred to, that there is a law in England under which the one in charge of a vehicle may be "had up" for obstructing the highways, even where such obstruction is very little, if at all, his own fault; and if this is true, then the driver of a traction engine or automobile may be between the devil and the deep sea. If he does not take water he is fined for obstructing the highway, and if he takes it he is fined for the taking. Possibly when, if ever, the traction engine and the automobile have displaced the horse upon England's highways, the troughs which have been dedicated to the use of the horse will be thrown open to the use of the road locomotives.

Standard Hose Couplings.

The following interesting particulars regarding the adoption of a fire-hose coupling standard by the National Fire Protection Association and other bodies, appear in the October issue of *Insurance Engineering:*

As far back as 1873 efforts were made to establish a standard for hose couplings for fire department use, and although these efforts were repeated at various times since, no concerted action was secured which insured the success of the movement until this year. In February the National Fire Protection Association appointed a committee consisting of F. M. Griswold, chairman; G. E. Bruen and H. C. Henley, to prepare a standard. Through the personal efforts of the members of this committee, especially Chairman Griswold, who has been actively interested in the matter for many years, the necessary co-operation of different bodies of engineers was secured.

The following standard was adopted at the annual meeting of the National Fire Protection Association:

NATIONAL FIRE PROTECTION ASSOCIATION STANDARD.

Adopted May 26, 1905.

Inside diameter of hose, in in..	2½"	3"	3½"	4½"
No. of threads per inch.....	7½	6	6	4
Male Couplings.				
Outside diameter of threads *finished*..... ..	3 1-16	3⅝	4¼	5¾
Diameter at root of threads....	2.8715	3.3763	4.0013	5.3970
Clearance between male and female thr'ds..	.03	.03	.03	.05
Length of threaded male end....	1"	1⅛"	1⅛"	1⅝"

NOTE.—The above to be of 60-degree V-thread pattern, with one-hundredth inch cut off the top of thread and one-hundredth inch left in the bottom of the valley in 2½-, 3- and 3½-inch couplings, and two-hundredths inch in like manner for the 4½-inch couplings, and with ¼-inch blank end on male part of coupling in each case; female ends to be cut ⅛ inch shorter for endwise clearance. They should be also bored out .03 inch larger in the 2½-, 3- and 3½-inch sizes, and .05 inch larger in the 4½-inch size in order to make up easily and without jamming or sticking.

This standard has been approved and adopted by the American Water-Works Association, the North Carolina State Firemen's Association, the International Association of Fire Engineers, the National Firemen's Association and the New England Water-Works Association. It has also received the endorsement of the Committee of Twenty of the National Board of Fire Underwriters and of the associated factory mutual fire insurance companies, and there is promise of adoption by the United States Government through the Bureau of Standards, Department of Commerce and Labor.

The use of the same hose coupling standard throughout the country will mean that neighboring cities and towns can readily help each other in fighting conflagrations; in fact, large cities some distance apart will be able to assist each other as easily as if the fire departments were one.

The great need of a standard of this kind was strongly emphasized by the Baltimore conflagration. As the earliest attempts to secure a standard were made shortly after the Chicago and Boston conflagrations, it is pretty safe to say that the difficulty of adapting couplings of different threads was experienced at those fires.

The success of the recent efforts, like the results of many other important undertakings of the same nature, must be credited chiefly to the fire underwriters of the country.

It is reported that 21,000 tons of steel rails have been ordered from rail mills in Spain, for delivery in California, and that the cost of these rails there is about $27 a ton, or about $1 a ton less than rails are selling for here. It is quite certain, however, that steel rails are produced in America at considerably lower cost than in Spain.

New Tools and Machine Shop Appliances.

ELECTRIC-DRIVEN PORTABLE DRILLS.

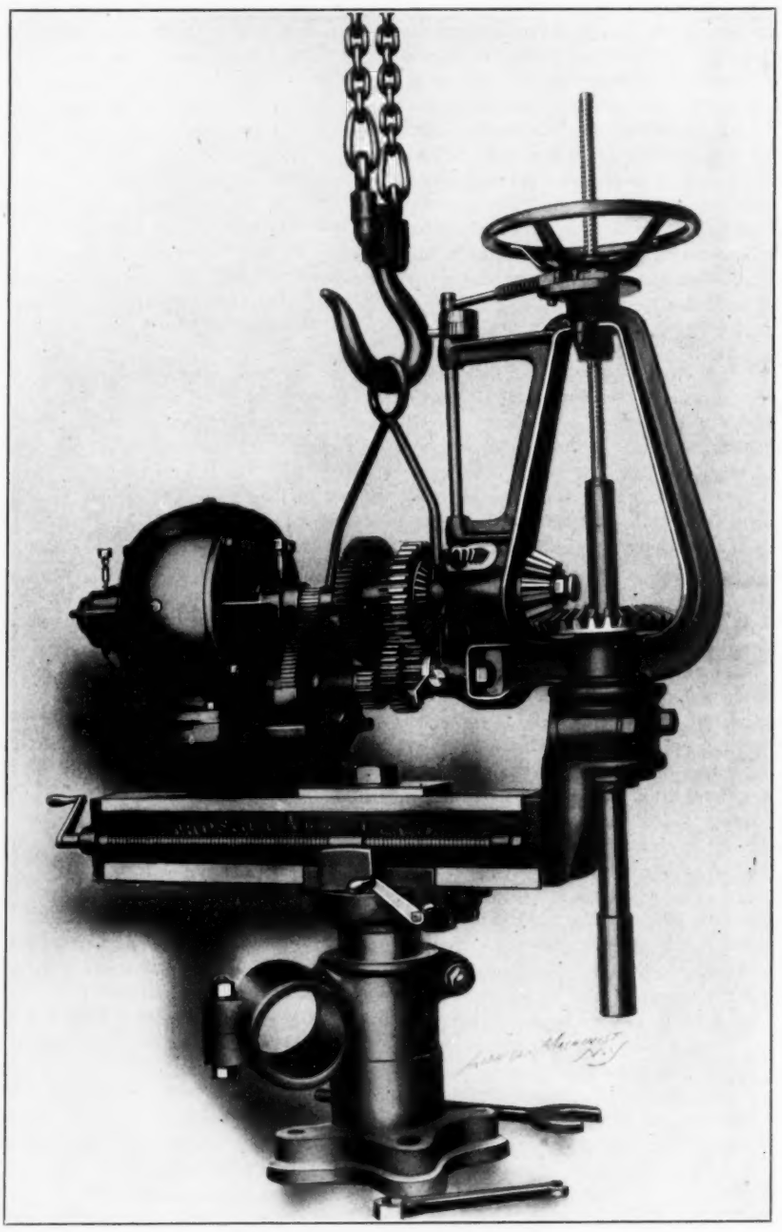
The great majority of our readers are no doubt familiar with the rope-driven portable drills made by the Thos. H. Dallett Company, of Philadelphia. This concern is now redesigning its entire line of portable drills to adapt them for motor drive, using standard motors. The Nos. 4 and 5 drills, which had for some time been furnished with motors made by the manufacturers of the drill, and a planetary gear reduction, are now on the market in the new form, one of the No. 5 machines being shown in the accompanying cut. The No. 4 is practically identical in general design. The motor shown on the machine illustrated is a 3-horse-power variable speed, 220-volt, made by the Northern Electric Company. The controller and switch are mounted on the motor bracket on the opposite side, and hence do not appear in the photograph.

These machines are provided with a sling for convenient handling by crane, and are in very extensive use where a portable machine is required for doing heavy or awkward drilling or boring. They are also very well adapted for a large range of regular work when not employed for a portable purpose, as these two sizes of machines being so powerfully back-geared, will do the same work that a very large standard drill press or radial can accomplish. The capacity of the machines for different purposes is only limited by the ingenuity of the operator using them for adapting them to various situations and uses.

The machine consists of a base containing two bearings, one vertical and one horizontal, allowing of being used for either vertical or horizontal drilling, this base being provided with four slotted lugs by which it can be bolted on or near the piece to be drilled or bored. In this base is fitted a post, having an adjustment therein, and allowing for the use of different lengths of drills and sockets used in the spindle. On this post, on the top of which is cut a worm-wheel, is fitted a cap-washer, containing on one side a bearing with a worm, which meshes in the worm-wheel on post, by which it can be entirely revolved around the axis of the base. The arm of the machine rests in a groove planed across the top washer, and is clamped firmly in place by a square washer on the top of same and a stud tapped into the post. The arm has a movement lengthwise at right angles to the axis of the base, is actuated by a side-screw, and has on the front end a clamp bearing to receive the drill-head. This drill-head consists of a frame with spindle, feed-screw and feeding device. The feeding mechanism in the No. 4 and No. 5 drills consists of a pair of bevel gears, feed-shaft, rocker, pawl-plate, pawl, ratchet, wheel, feed, nut and feed-screw, the latter pressing directly upon the top end of the spindle, the thrust being taken by a fiber-washer; coupling to the spindle is by a yoke nut. The connecting rod between the crank and rocker pawl is fitted with a spring which can be set for any pressure of feed, so that when this pressure is exceeded the spring will be compressed and the feed cease to operate until the excessive pressure of feed is relieved, thus making an automatic relief.

Change of feed from one tooth to seventeen can be effected by shifting thumb-latch, no wrench being required. The No. 4 and No. 5 drills are fitted with a back gear, which is thrown in mesh by an eccentric shaft, the latter being locked in place with a thumb-screw. When the back gear is in use the key is unclutched from the cone-shaft by throwing out a clutch-key.

The motors used are variable-speed motors, sufficiently powerful to operate the machine to the extreme limits of its capacity without undue heating. The bearings of the motor are so arranged that the motor is equally serviceable in whatever position the machine may be placed.



ELECTRIC-DRIVEN PORTABLE DRILL.

The No. 5 portable has a reach of arm of 36 inches, drilling at one setting anywhere over a surface of 72 inches outside diameter and 22½ inches inside diameter. The spindle is provided with a No. 5 Morse taper, has a diameter of 21-16 inches and a traverse of 20 inches, and the

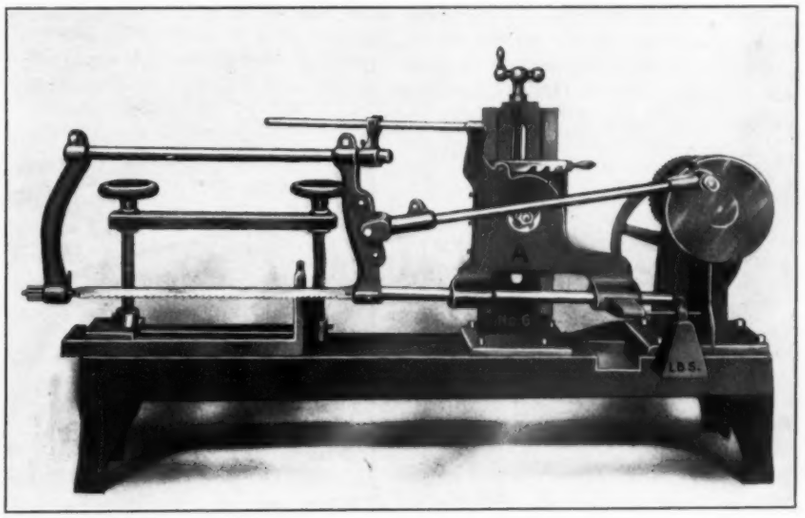
range of speeds is from 19 to 90 revolutions per minute, with a feed of from .005 inch to .075 inch per revolution of spindle. The net weight of machine, complete, is 1,300 pounds.

The No. 4 machine, as stated before, is practically identical in design with the No. 5, the arm having a range of 28 inches, drilling at one setting anywhere over a surface of 56 inches outside diameter and 16 inches inside diameter. It has a spindle traverse of 12 inches, with a diameter of spindle of 1-11-16 inches, provided with a No. 4 Morse taper. This machine has a range of speed from 29 to 153 revolutions per minute, with the same feeds per revolution of spindle as the No. 5, the vertical adjustment of the post in the base being 6 inches, as against 8 inches in the No. 5 machine. The net weight of the No. 4 machine is 765 pounds.

The manufacturers are rapidly adapting their other sizes of portable drills to the reception of standard motors, and in a short time will be prepared to furnish any of these different drilling machines so equipped.

A MOTOR DRIVEN SPEED LATHE.

This lathe is driven by a motor which is mounted upon a bracket fastened to the back of the lathe. The motor is of the variable speed type, with speeds from 600 to 1,800 turns per minute. Upon the spindle of the motor is mounted a two-step cone pulley which belts to a two-step cone pulley on the lathe spindle. These pulleys, in connection with the motor, give a range of speed to the lathe spindle of from 240 to 1,650 turns per minute. The controlling device is placed in the leg underneath the head and operated by lever as shown at the front. The head of this lathe may be placed upon the bed as shown or reversed as is usual for pattern-makers' lathes. The tailstock has both screw and lever feed. The lathe can be furnished with slide rest, cut-off rest, or turret as desired. It is built by the J. G. Blount Company, Everett, Mass.



A POWER HACK-SAW.

A POWER HACK-SAW.

The illustration shows a power hack-saw having features not usually found in saws of this class.

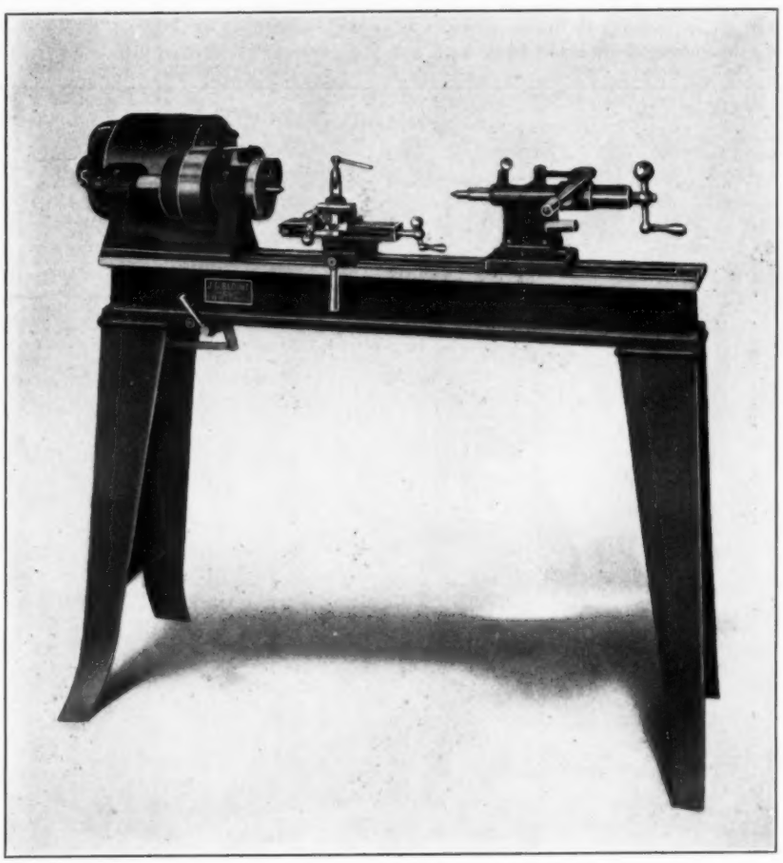
The upright *B* is provided with a slide, upon which a carriage is fitted. The part *A*—which carries the guides for the saw frame—swings upon a central stud in the carriage, and is so arranged that the saw may be raised above, but not depressed below, a horizontal position. From the foregoing it is therefore obvious that the depth of cut depends upon the vertical position of the carriage—which supports *A*—upon the upright *B*. Thus if a piece is to be cut entirely off, the carriage is set at the bottom of the slide; but if a saw cut is to be taken to a certain depth only, the carriage is set for that depth.

The action of the saw is this: The carriage is set to the desired position on the upright *A*. The saw is then tilted up until the latch at the top of the swivel *A* catches the pin on the carriage. The work is then clamped in the vise, the latch is lifted, the saw lowered to the work, and the saw started. When the saw reaches a horizontal position the feed ceases.

The slotted crank-disk permits the stroke to be altered. The machine is geared 3 to 1; its capacity is 12x12 inches. The vise is removable and may be set at an angle. The weight of the machine is about 600 pounds. It is built by the Robertson Manufacturing Company, Inc., 1848 Niagara street, Buffalo, N. Y.

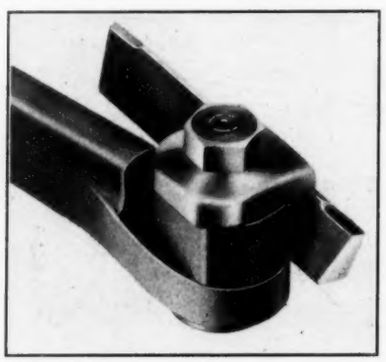
SIDE TOOL HOLDER.

This tool is known as the "Quadruple" side tool holder and has a swiveling head that can be turned entirely around and set at any angle, so that the opposite ends of a blade can be ground right and left, or two blades can be used; and the blade



A MOTOR-DRIVEN SPEED LATHE.

can be quickly set at any angle without disturbing the holder in the tool-post. The holder is made of drop-forged machinery steel, case hardened; the post and cap are machinery steel; the collar is tool steel, hardened, and the blade is of high-speed steel. It will be noticed that the blade is supported on three sides and so clamped as to draw up tight and rigid against the

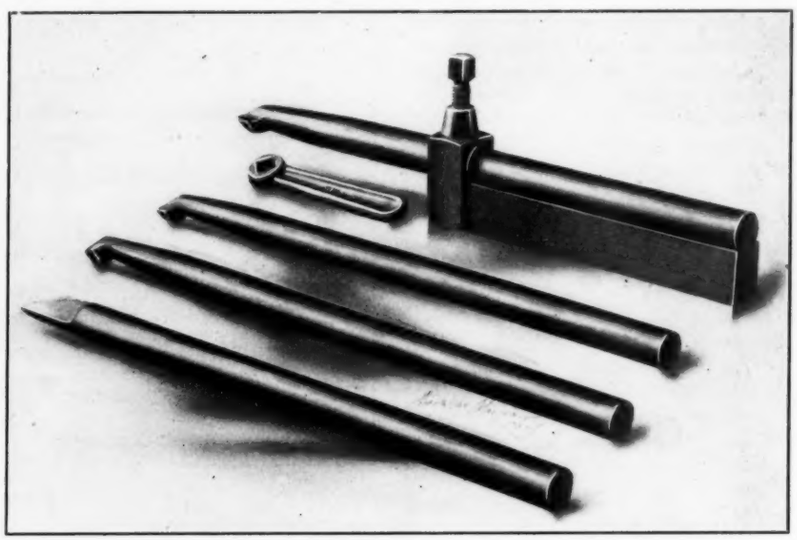


SIDE TOOL HOLDER.

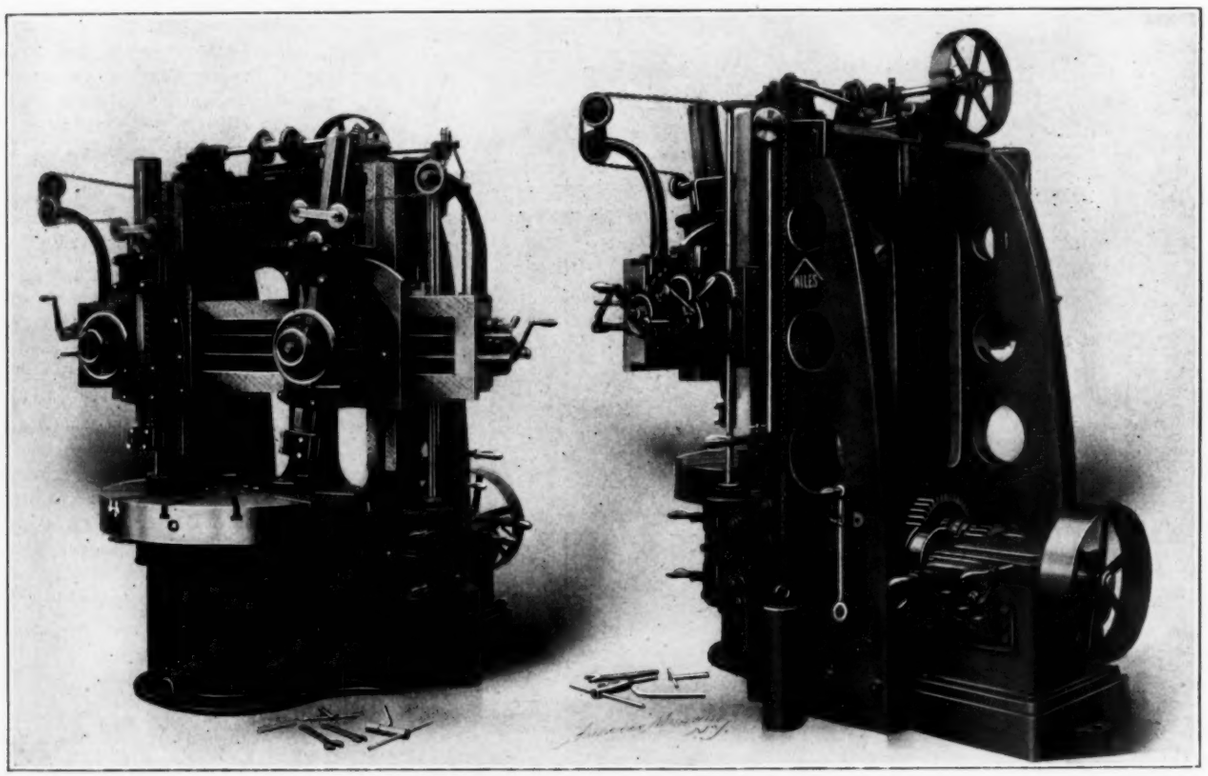
head. The makers are the Bown Machine Company, Ltd., Battle Creek, Mich.

42-INCH BORING AND TURNING MILL.

As will be seen from the two views, this mill is driven by a plain pulley, and through a gear box and back gears sixteen changes of speed in geometrical progression are obtained for the table, these speeds being controlled by the handles clearly shown at the rear. The machine swings 42 inches, takes work 30 inches under the tool-holders, and has two independent swiveling heads on the cross-rail capable of being set to any angle. The octagonal steel bars have 20 inches ttravel, are scraped to bearings on four sides, and have counterweights, and no part of the machine extends below the floor. There are eight changes of feed, operated horizontally on the heads and vertically and angularly on the boring-bars, consisting of nested gearing in feed-boxes at each side of the machine, entirely independent for each head both as to amount and direction. They are reversed or changed from fine to coarse by levers, giving four roughing and four finishing feeds. Changes for a given set are obtained by sliding gears at the end of the cross-rail. The latter is of deep, box-girder form, strongly arched between the housing, and elevated and lowered by power. The table has an annular bearing near the circumference, and is driven by bevel gearing, and has a long spindle provided with a taper bush at the top for taking up wear and with a lower step to



A BORING TOOL HOLDER.



42-INCH BORING AND TURNING MILL.

run in oil. The bed, housings, back and top brace are cast integrally to insure rigidity and alinement of the members. When a motor drive is desired, a constant-speed motor is placed on top of the speed-box and geared directly to the pulley-shaft. The machine is built at the Niles shops—Hamilton, Ohio—of the Niles-Bement-Pond Company, New York city.

A BORING-TOOL HOLDER.

The illustration shows a very handy holder for boring tools. The tools are made of round steel, the only forging necessary being that required to form the cutting end. It is made by the Gem Manufacturing Company, 467 Eleventh avenue, Milwaukee, Wis.

Enlargement of the Bertram Plant at Dundas, Ontario.

Extensive additions and improvements are being made to the plant of the John Bertram & Sons Company, Ltd., Dundas, Ontario, Canada. A new foundry building, which will embody the most modern ideas in construction and appointments, is already well under way. The structure will be 209 feet long, with provision for extending to 500 feet. The center bay is 50 feet and the side bays 32 feet wide, making a total width of 114 feet and providing 32,600 square feet of floor space. The west bay will have a gallery, with reinforced concrete flooring its entire length. This will be used as a charging floor and for sand and coke storage. The storage bins will be served by a system of chutes whereby the coke and sand will be received directly from cars.

Ample light, enabling the men to work in the deepest hole, will be provided by skylights and two rows of side windows. Provision is made for ventilation by the swinging of the upper row of side lights. The crane equipment will include one 10- and one 25-ton traveling crane for the center bay, 5-ton cranes for the side bays and a 5-ton crane over the core room. The yard between the foundry and extended machine shops will be covered by a large traveling crane with 60-foot span. Transportation facilities will include railroad service for the yard and tracks running into the foundry.

The old foundry building, after the completion of the new foundry, will be converted into a machine and erecting shop, served by a 30-ton traveling crane, under which all the heavy class of tools will be built. The building will be extended to 280x50 feet, and when completed will give three erecting shops suitable for various classes of work and served by 10, 15 and 30-ton cranes, respectively. The present No. 1 shop will remain a two-story manufacturing shop for small parts. With these extensions over 55,000 feet of machine and erecting shop floor space will be given.

The works will be operated by electric power and an air plant for the new foundry will be installed.

T. A. Somerville, formerly with the Canadian Pacific Railway's Angus shops and the Canada Car Company, Montreal, has charge of the construction and improvements. The Phœnix Iron Works, Montreal, have the contract for the steel work. M. J. Haney and Roger Miller, Toronto, are contractors for the balance of the work.

For the manufacture of its full line of small tools, including taps, dies, reamers, milling cutters, punches, etc., a plant has been purchased in Dundas, near the Bertram works, and will be used by the Pratt & Whitney Company. The building is a modern structure and will afford at present 12,000 feet of floor space. Machinery for the plant is being shipped from Hartford and work will commence shortly. A twist drill department will also be included in the plant. An elaborate equipment of special machinery for this department is ready for installation. This small tool plant, which will soon be enlarged, will be operated as one of the departments of the Bertram works.

Meeting of the American Society of Mechanical Engineers.

The fifty-second meeting of the American Society of Mechanical Engineers will be held in New York city during the first week in December.

The headquarters, instead of being at the Society House, 12 West Thirty-first street, as in previous years, will be at the Edison Building, 44 West Twenty-seventh street, the two upper floors being used.

The opening session, at which President John R. Freeman will present the annual address, will be at 44 West Twenty-seventh street on Tuesday evening, December 5.

The second or business session will be held Wednesday morning in the main saloon of the steamship "Amerika" at the docks of the Hamburg-American Line, at Hoboken, N. J.

Following this session a special train will take those desiring to make the excursion to the new Henry R. Worthington Hydraulic Works, at Harrison, N. J.

Wednesday evening there will be an illustrated lecture at 44 West Twenty-seventh street, by Prof. R. W. Wood, of Johns Hopkins Uiversity, on "Photography of Invisible Phenomena."

The third session will be on Thursday morning at 44 West Twenty-seventh street, and besides the presentation of professional papers there will be a discussion on the subject of "Bearings."

Thursday afternoon there will be a reception at the New York School of Automobile Engineers, 146 West Fifty-sixth street.

The usual reception at Sherry's will occur on Thursday evening.

The closing session will be at 44 West Twenty-seventh street on Friday morning, and will be devoted to the presentation of professional papers.

We have received a copy of the report of the two meetings held in Chicago, October 26 and 27, to consider the interstate commerce law and the regulation of railroad rates. It will be remembered that the convention called to consider these matters split in two, and that two conventions were, therefore, held at the same time but in different halls. The report before us is in full of what took place at both meetings, and is issued by the Federal Rate Regulation Association of St. Louis, Mo., of which N. W. McLeod is chairman.

At a meeting and banquet of the Technical Publicity Association, held at the Aldine Club, New York, Friday evening, November 3, the following officers were elected: President, C. B. Morse, Ingersoll-Rand Drill Company; first vice-president, H. M. Cleaver, Niles-Bement-Pond Company; second vice-president, Frank H. Gale, General Electric Company; secretary, Rodman Gilder, Crocker-Wheeler Company; treasurer, H. M. Davis, Sprague Electric Company; members of Executive Committee: Graham Smith, Westinghouse Companies, and Chas. M. Manfred, Johns-Manville Company. H. M. Davis addressed the association on "The Advertising Appropriation." An informal discussion followed, in which the members exchanged views on the disposition of advertising appropriations, the relative amount that should be spent in magazine and circular advertising, the relation between the advertising appropriation and the volume of business, etc.

Personal.

Robert Mc. F. Doble, consulting engineer, of San Francisco, has severed his connection with the Abner Doble Company in order to resume his individual practice.

Frank H. Thompson, formerly connected with the patternmaking department of the Stanley Electric Company, of Pittsfield, Mass., is now an instructor in patternmaking at Cornell University.

Prof. A. W. French, of the Worcester Polytechnic Institute, is writing a treatise on "Concrete and Reinforced Concrete," which will form a part of the new edition of Trautwine's Engineers' Pocket Book.

C. H. Dunbar ('91, Worcester Polytechnic Institute), who has been with the Elgin (Ill.) Gas Company as superintendent, has been elected secretary and manager of the Houston (Texas) Gas Company.

W. L. Darling, formerly chief engineer of the Chicago, Rock Island & Pacific Railway, and who is a graduate of the Worcester Polytechnic Institute in the class of '77, has resigned to take charge

of construction work on the Pacific Railway.

H. C. Crandall has resigned his position as superintendent of the Milwaukee works of the International Harvester Company, and will hereafter be connected with the J. I. Case Company, of Racine, former owners of the harvester works referred to. Mr. Crandall has spent nearly twenty-four years in the harvester factory, having started as a workman at the bench, and worked his way up to the position of superintendent, which position he has held for the last ten years.

Obituary.

Charles White, for nearly half a century identified with the street railways and iron construction work in Washington, died recently in that city at the age of seventy-one years. He was born in Ellicott City, Md., went to Washington as a young man and established structural iron works. He was the first in the South to utilize the truss principle in bridges, invented by his father-in-law, Nathaniel Ryder. Much of the iron work for the Capitol, the Treasury, Patent Office and Post Office departments and other Government buildings erected before and just after the Civil War was furnished by Mr. White, as was also the material for several of the street railways. He was formerly identified with the management of three of the companies and inaugurated the present system of interchangeable car tickets.

Business Items.

The Independent Pneumatic Tool Company, Chicago, Ill., reports a large demand for the "Thor" tools and appliances, and will enlarge the plant at Aurora, Ill.

Wilmarth & Morman Company, Grand Rapids, Mich., is shipping a great deal of machinery to foreign lands, particularly to England, France and Norway.

The Griffiths & Jones Company, Baltimore, Md., has recently opened a machine shop as general machinists, die sinkers, and die makers. Mr. Griffiths, who has been connected with some of the largest concerns in Baltimore, is manager of the company.

The B. F. Sturtevant Company, Boston, Mass., is to furnish fans for ventilation of portions of the United States Capitol, Washington, D. C., which are now undergoing repairs.

The Fawcus Machine Company, Pittsburg, Pa., has recently completed an addition to its plant, both building and machinery, which doubles its capacity. Notwithstanding these additions, this company is now running both a day and night force and still greater additions are in prospect, land having been purchased for the erection of another two-story machine shop.

The Boston Gear Works, Boston, Mass., are contemplating the removal of their plant to Norfolk Downs, Mass., where they will erect a modern factory with greatly enlarged capacity. The purpose of the company in moving is to gain greater facilities for handling their rapidly increasing volume of business. Norfolk Downs is a suburb of Boston, about fifteen minutes' ride from the South Terminal Station

Owing to the rapidly increasing Southern business of the past year, the De La Vergne Machine Company, of New York, has established a branch agency at Atlanta, Ga. This agency is to cover the States of North Carolina, South Carolina, Alabama, Florida and Georgia. This agency will handle business connected with the three lines of machinery manufactured by the De La Vergne Machine Company, viz.: refrigerating and ice-making machinery, "Hornsby-Akroyd" oil engines and Koerting gas engines. The company's representative will be W. M. Hargreaves, and the office will be located at 510 Candler Building.

E. W. Bliss Company held its annual meeting on October 20 at the offices of the company, Adams and Plymouth streets, Brooklyn, N. Y., and elected the following directors for the ensuing year: J. W. Lane, F. C. B. Page, W. J. Grinden, W. B. Batley, W. H. Truesdale, Seth L. Keeney, Chauncey Marshall, F. M. Leavitt, A. Wilzin, W. E. Murdock, J. J. Flynn, F. D. MacKay, T. B. Kent. Immediately after the stockholders' meeting, the directors elected the following officers: President, J. W. Lane; vice-president, F. C. B. Page; second vice-president, W. J. Grinden; secretary, H. C. Seaman; treasurer, L. H. Gould.

The New Process Raw Hide Company, Syracuse, N. Y., has announced its intention of going more extensively into the manufacture of metal gears of all kinds, as well as its well-known New Process Noiseless Pinions. In furtherance of this plan the company has just completed a two-story brick addition containing 10,000 feet of floor space, and is installing a number of additional turret lathes, drills, grinders, spur-gear cutters, bevel-gear planers and other machinery necessary for the manufacture of accurate gearing. This additional equipment will increase the company's capacity about 75 per cent. Business with this concern is very brisk, and it reports shipments as considerably in excess of last year, with prospects very bright for a continuance of same.

Manufacturers.

E. H. Gorham, Oneonta, N. Y., is erecting a new machine shop.

The Meriden (Conn.) Brass & Iron Works will erect a new factory.

The Krom Machine Works, Jersey City, N. J., will move to Norwood, Pa.

A. Van Camp, Decatur, Ind., will erect a large addition to his machine shop.

The Denver & Rio Grande Railroad will erect new car shops at Pueblo, Colo.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad st., New York.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Wanted—A power press, capacity 12 in. ring, 60 in. cutting surface, No. 25 iron, for cash. Fidelity Eectric Co., Lancaster, Pa.

Draftsman.—Drawings, tracings, plans, details, Patent Office drawings, and machinery designed. Address P. O. Box 167, Brooklyn, N. Y.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted to Purchase—One gear cutter that will cut a gear wheel 71 in. in diameter, 10 in. face, 2¼ in. circular pitch or smaller; a second-hand machine in good order would be considered. Write the Ottumwa Iron Works, Ottumwa, Iowa.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

M. R. E. Mathot, the well-known Belgian gas engine expert and author, is visiting the United States, and invites correspondence and consultation. His itinerary is as follows: Detroit, Nov. 18; Chicago, Nov. 21; Cincinnati, Nov. 30; New York, Dec. 11. Correspondence addressed to M. Mathot, in care of the American Society of Mechanical Engineers, 12 West 31st st., New York, will be forwarded.

For Sale.

Complete mechanical course, International Correspondence School; will sell cheap. Box 790, AMERICAN MACHINIST.

For Sale—U. S. Patent Right No. 730,757, rotary roasting oven for drying grain or baking cereal foods. Address I. B. Galbreath, Decatur, Mich.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale by the Inventor—U. S. Patent No. 786,824; will consider partnership proposition with services included. Address "R. C. L.," care AMERICAN MACHINIST.

Business Opportunities.

Gentleman, established in Belgium, visiting New York, well introduced in Belgium, France, Germany, wishes to represent American tool manufacturer. Box 775, AMER. MACHINIST.

A prosperous foundry and machine works in Atlanta, Ga., desires to arrange with manufacturers or patentees for the right to manufacture staple articles of steel and iron suitable for sale in the South. Box 787, AM. M.

Wanted—Practical accountant and business man as treasurer of an established manufacturing business; must be able to show a successful record as accountant and office man, and invest from $5,000 to $10,000 in stock of company. Address, with full particulars of experience, ability and references, "J. B.," care AMERICAN MACHINIST.

Wanted—An experienced foundryman to join others in the purchase and operation of an established job foundry with an assured tonnage of 100 to 150 tons per month; must be able to show a successful record and invest from $5,000 to $10,000. Address, with full details of experience in mixing metals, managing help, references, etc., "G. P. M.," AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

General manager, with large experience in organizing new and old manufacturing plants in United States and Canada, is open for engagement; technical graduate; age 35. Box 798, AMERICAN MACHINIST.

CONNECTICUT.

Experienced young man on machinery cost work desires position in office of large concern; good mathematician; best references. Address Box 816, AMERICAN MACHINIST.

Responsible position, by young man, 17

years' experience in shop and as assistant superintendent and chief draftsman on medium and light work; can introduce modern, systematic methods and show results handling men. Address Box 812, AMER. MACHINIST.

FOREIGN.

University graduate, speaking German and Swedish, would like to represent an American manufacturing concern in Europe with headquarters at Berlin; said graduate is an American with technical education and experience, good address and natural born salesman. Not open for engagement until June, 1906; however, in the meantime would begin the study of the new work at once and put in part time in Chicago and vicinity. Box 806 AM. MACH.

ILLINOIS.

Machine shop superintendent, 37 years of age, wide experience on a large variety of work, desires position. Address Box 814, AMERICAN MACHINIST.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

MASSACHUSETTS.

Young man, experienced in drafting and designing textile machinery; New England. Box 811, AMERICAN MACHINIST.

Mechanical draftsman, with 13 years' shop and drafting experience, designer with ability, desires position; will go anywhere. Box 793, AMERICAN MACHINIST.

Grinding-room foreman wants change; finest B. & S. universal and surface grinding; long experience; references. "Jubilum," care AMERICAN MACHINIST.

NEW JERSEY.

A foreman patternmaker, now in charge of a marine shop, would make a change, and would like to hear from a firm who want a first-class wood pattern maker; best of reference. Address Box 819, AMER. MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 813, AMERICAN MACHINIST.

Machinist, toolmaker, all-around man (German, 23), wants position. Box 805, AM. M.

Steel expert on carbon and all high-speed steels would like to make a change. "H. H. H.," care AMERICAN MACHINIST.

Young man with reputation, at present superintendent for up-to-date, successful concern, desires change; replies treated confidential. Box 815, AMERICAN MACHINIST.

Graduate M. E. (age 30); 2 years shop, 9 years office, as designer, inspector, etc., on special and small machinery, jigs, fixtures, instruments and experimental work; practical and inventive man; shop or office position, or both. Box 801, AMERICAN MACHINIST.

PENNSYLVANIA.

Foreman patternmaker wishes to correspond with parties wishing up-to-date, live man; best of reference; 20 years' experience. Box 803, AMERICAN MACHINIST.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Superintendent of machine and iron works; many years' practical experience; skilled in design, invention and difficult construction; familiar with details of modern shop practice; advantageous handling of help, etc.; open for engagement; high and responsible references. Address Box 804, AMERICAN MACHINIST.

WISCONSIN.

Position as foreman of lathe or turret lathe department, or as inspector of finished work; good references. Box 794, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—For large electrical factory in Canada, several first-class mechanics as foremen and inspectors in machine shop. Apply, stating experience and wages, to Box 808, AMERICAN MACHINIST.

CONNECTICUT.

Several first-class, all-around machinists are wanted by firm manufacturing elevators, clay-working machinery, friction clutches, etc.; men capable of doing erecting or repair work when required; steady work for right men. The Eastern Machinery Co., New Haven, Conn.

We are constantly adding to our force, and invite applications from machinists, toolmakers, diesinkers drop forgers, erectors and patternmakers, also lathe, screw machine and bench hands; in applying, please state age, experience and wages wanted. Locomobile Company of America, Bridgeport, Conn.

GEORGIA.

Wanted—A first-class toolroom man, a No. 1 machine draftsman, a machine shop speeder, a gang drill press foreman and an all-round printing office man; permanent jobs for right parties. Address, with references and full particulars, De Loach Mill Mfg. Co., Atlanta, Ga.

ILLINOIS.

A large structural steel manufacturing concern in Chicago invites applications from thoroughly competent men, for position of general foreman in their shop; applicants, to receive consideration, should state fully their experience, references and present place of employment; no applications are desired from men who do not consider themselves competent to secure the highest salaries paid for this class of service. Box 744, AM. MACH.

INDIANA.

Wanted—Two first-class operators for Jones & Lamson screw machines. Must be able to operate machine to full capacity. Call or address, Nordyke & Marmon Co., Indianapolis, Ind.

MARYLAND.

Toolmakers wanted on automobile work; competent toolmakers; must be first-class men who will appreciate steady employment. Address Pope Manufacturing Company, Hagerstown, Md.

MASSACHUSETTS.

Wanted—By a large electric manufacturing company, a man to estimate factory costs; state full particulars and salary expected. Address Box 810, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good, all-round men on special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

Wanted—First-class engineer to take charge of power plant, containing up-to-date compound condensing engines, boilers, electrical generators and motors; works situated in central Massachusetts; state age, experience and compensation expected. Box 807, AM. MACH.

MICHIGAN.

Wanted—Draftsman who is thoroughly familiar with jig and tool designing, also familiar with automobile work, to assist chief draftsman; also draftsman for checking, who is familiar with automobile work. Box 797, AMERICAN MACHINIST.

Wanted—Machinists, vise hands and molders; we are steadily increasing our business, and desire to keep in touch with all classes of automobile workmen. If you are out of work, or not satisfied with your present position, write General Superintendent, Olds Motor Works, Lansing, Mich.

Wanted—We still have room for a few more first-class toolmakers. If you have had good experience on making jigs, fixtures and test tools for interchangeable machinery and would like to get a position in an up-to-date tool department, with good wages, write to the Cadillac Motor Car Co., Detroit, Mich.

Wanted—Foreman to take charge of field-winding and insulating department; must be steady and familiar with latest improved methods of field coil winding; reply in full, giving age, reference, married or single and salary expected; to receive consideration, applicant must give above information in detail. Box 809, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—By manufacturing concern near Newark, two mechanical draftsmen at once; must be accurate; permanent position. Box 795, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Draftsmen wanted; those preferred who have had some years' experience on heavy machinery; good wages to competent men; give experience in full; drafting work will be done at the plant, Stewartsville, N. J.; draftsmen live in Easton, Pa.; transportation by D. L. & W. trains, fare 5c. each way; state wages wanted. Address Edison Portland Cement Co., Stewartsville, N. J.

NEW YORK.

Machinists.—Wanted—Good, all-around machinists. Gifford-Wood Co., Hudson, N. Y.

Wanted—Bright young men with mechanical inclinations, to become machinists in special line. Address Box 800, AMER. MACH.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 708, AMER. MACHINIST.

Wanted—A chemist; one familiar with strength of materials, also the best foundry practice; must be able to recommend material to accomplish certain results. Box 817, A. M.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Milling machine operators, capable of setting up their own machines, reading blueprints and being able to do first-class tool machine work; if not first-class, do not apply. Address G. M. H., Box 129, 617 6th ave., New York City.

Bright young mechanic, familiar with small fine work, to learn to care for some special machinery in a manufacturing plant; will pay $20 per week, or better, to satisfactory man; non-union preferred. Apply to Box 799, A. M.

Wanted—Superintendent for machine shop employing about 250 men; must be good mechanic, with executive ability; must be thoroughly competent and experienced on printing presses, tools and interchangeable machinery; only first-class men with successful records need apply, giving experience, reference, etc. Address "Newark," care AMER. MACHINIST.

Wanted—Superintendent to take charge of an established and up-to-date plant manufacturing a line of A1 machine tools; must have push, energy and good executive ability, also be well up in modern machine shop practice; only men of ability need apply; state age, experience, salary expected, with references; all correspondence will be treated strictly confidential. Address Box 726, AM. MACH.

Tool Designer.—A company of established reputation, employing 1,600 hands, requires a man to devise tools and manufacturing methods for producing large quantities of small, strictly interchangeable parts; he will be responsible for results to one man only, and will be assisted by the chief draftsman and his staff; applicants will please state age, nationality and extent of education; also give a list, covering present and former positions, specifying the name of each employer, the nature of each position held and the dates between which employed; this information is requested on the understanding that it will be treated as strictly confidential; no inquiries will be addressed to any person you mention, without first obtaining your consent. Address "Confidential," Box 821, AM. MACH.

OHIO.

Wanted—First-class man for case-hardening. Box 802, AMERICAN MACHINIST.

Wanted—A mechanical draftsman, experienced in steam engine designing; must be a technical graduate, capable of doing the routine figuring of the drafting room; state age, experience, education and salary expected. Address The Hooven, Owens, Rentschler Co., Hamilton, O.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMER. MACHINIST.

Wanted—Machinists and patternmakers. We are constantly adding to our force, and invite applications from machinists and patternmakers, preferably those accustomed to engine work. Shepherd Engineering Company, Franklin, Pa.

Erecting foreman; experienced on high-grade machine tools; location, Pennsylvania N. W.; new works; every facility; only competent men with record for accurate work and ability to manage men and work economically neer apply; state past employers, capacity and length of service, age, nationality, etc; letters confidential, returned if desired. Address Box 796, AMERICAN MACHINIST.

VERMONT.

Wanted—Young man, technical graduate, with machine shop experience, for assistant engineer. Vermont Marble Co., Proctor, Vt.

VIRGINIA.

Wanted—Machinists with experience in building elevator machinery. The J. B. Westbrook Foundry & Machine Company, Danville, Va.

Mechanical draftsman wanted who understands machine design and repairs and has practical shop experience; prefer one who has worked under a shop engineer; state experience and salary expected. Address "L. N. G.," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—Good salesman in power-transmission line, to look after branch house; must be a man of executive ability; none but first-class men should apply. Box 818, A. M.

Wanted.—A new machinery house opening in St. Louis desires the services of a machine tool salesamn of first-class ability and experience; in answering, state age, references, salary expected, average annual sales for the past 3 years and lines of tools sold. Box 820, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co.....124
Acme Machinery Co....34 and 86
Adams Co., The..... 95
Advance Mfg. Co.....119
Albro-Clem Elevator Co.....108
Almond Mfg. Co., T. R.....120
Alteneder & Sons, Theo.....110
American Gas Furnace Co... 14
American Pulley Co..... 93
American Tool Works Co.... 8
American Tube & Stamping Co.117
American Watch Tool Co..... 28
Armstrong Bros. Tool Co....
87 and 125
Athol Machine Co.....113
Auburn Ball Bearing Co..... 92
Automatic Machine Co..... 28

Backus Water Motor Co.....116
Baird Machinery Co..... 90
Bair & Gazzam Mfg. Co.....109
Baker Brothers..... 123
Baker Machine Corporation..112
Baldwin Chain & Mfg. Co.....112
Baldwin Steel Co.....118
Ball Bearing Co..... 34
Barnes Co., B. F.....114
Barnes Co., W. F. & John.... 14
Barnett Co., G. & H...4th Cover
Bartlett, E. E..... 95
Baush Machine Tool Co..... 24
Bay State Stamping Co.....111
Bay State Tap & Die Co..... 90
Beaman & Smith Co., The..
15 and 120
Becker-Brainard Milling Machine Co..... 23
Bemis & Call Hardware & Tool Co.... 87
Bertram & Sons Co., Ltd., John..... 14
Besly & Co., Chas. H..... 28
Bethlehem Fdry. & Mach. Co.115
Betts Machine Co..... 6
Bickford Drill & Tool Co.... 10
Bignall & Keeler Mfg. Co.....112
Bilgram, Hugo..... 34
Billings & Spencer Co..... 97
Binsse Mach. Co.....34 and 81
Birdsboro Steel Foundry & Machine Co..... 9
Blaisdell Machinery Co..... 95
Blanchard Mach. Co..... 34
Bliss Co., E. W..... 25
Blount Co., J. G..... 22
Boker & Co., Hermann..... 85
Booth, Wm. M.....119
Boston Gear Works.....108
Bown Machine Co.....125
Boynton & Plummer.....115
Bradford Machine Tool Co... 5
Bridgeford Mach. Tool Works. 25
Bridgeport Safety Emery Wheel Co..... 110
Bristol Co..... ....4th Cover
Brown-Cochran Co.... 116
Brown Co., H. B..... 91
Brown & Co., R. H.....120
Brown & Sharpe Mfg. Co....
75 and 4th Cover
Brown Hoisting Mach. Co....122
Buffalo Forge Co.....4th Cover
Builders Iron Foundry..3d Cover
Bullard Auto. Wrench Co....104
Bullard Machine Tool Co.... 32
Bury Compressor Co..... 87
Butler, A. G.....110

Caldwell & Son Co., H. W....122
Carborundum Co., The..... 27
Card Mfg. Co., S. W..... 17
Carpenter Tap & Die Co., J. M. 89
Case Mfg. Co.....122
C & C Electric Co.....103
Chadwick & Co., G. B.....125
Chambersburg Engr. Co.....112
Chandler & Farquhar Co..... 90
Chattanooga Machinery Co.... 22
Chicago Flexible Shaft Co....101
Chicago Rawhide Mfg. Co....109
Christensen, N. A..... 87
Cincinnati Machine Tool Co..123
Cincinnati Milling Mach. Co.. 7
Cincinnati Planer Co..... 9
Cincinnati Shaper Co.....126
Clark Cast Steel Cement Co..111
Clayton Air Compressor Wks. 87
Cleveland Auto. Mach. Co.... 18
Cleveland Cap Screw Co..... 96
Cleveland Crane & Car Co....122
Cleveland Pneumatic Tool Co. 87
Cleveland Twist Drill Co., The..... .....4th Cover
Clough, R. M.....92 and 111
Coates Clipper Mfg. Co.....112
Coes Wrench Co..... 23

PAGE

Colburn Machine Tool Co.... 22
Columbus Machine Co.....116
Cook Co., Asa S.....111
Cornell, J. B. & J. M.....118
Crescent Forgings Co..... 95
Cresson Co., Geo. V..... 93
Crocker-Wheeler Co..... 105
Crosby Steam Gage & Valve Co..... 17
Cumberland Steel Co.....111
Curtis & Co. Mfg. Co..... 91
Curtis & Curtis Co.....113
Cushman Chuck Co.....120
Cutler-Hammer Clutch Co....106

Dallett Co., Thomas H.....121
Davis, Rodney.....108
Desmond-Stephan Mfg. Co....124
Detrick & Harvey Mach. Co..118
Diamond Machine Co...3d Cover
Dickinson, Thos. L. 120
Dill Machine Co., T. C..... 22
Dixon Crucible Co., Joseph...111
Dodge & Day.....112
Dreses Machine Tool Co..... 16
Drucklieb, C..... 87

Earle Gear & Mach. Co.....109
Eastern Machinery Co.....110
Eberhardt Bros. Machine Co.108
Eck Dynamo & Motor Wks...104
Electro Dynamic Co.... 105
Elmes Engr. Works, Chas. F. 91
Emmert Mfg. Co.....113
Errington, F. A.....121
Evans Friction Cone Co.....124
Excelsior Needle Co.....111

Fairbanks Co.....90 and 113
Farrel Fdry. & Machine Co...118
Fawcus Machine Co.....108
Fellows Gear Shaper Co.....108
Felton, Sibley & Co.....112
Fenn-Sadler Machine Co.....104
Field, Chas. H.....119
Firth-Stirling Steel Co.....118
Fitchburg Machine Works.... 94
Foos Gas Engine Co.....116
Fosdick Machine Tool Co.... 15
Franklin Mfg. Co.....107
Frasse & Co., Peter A.....118

Ganschow, Wm..... 109
Garvin Machine Co., The..... 96
Geier Co., P. A.....125
General Electric Co.....102
General Mfg. Co.....110
General Pneumatic Tool Co..123
Geometric Tool Co..... 29
Gilmore Electric Co.....107
Gisholt Machine Co..... 1
Gleason Works.....4th Cover
Goldschmidt Thermit Co.....118
Gorton Machine Co., Geo..... 91
Gould & Eberhardt..... 79
Graham Mfg. Co.....113
Grant Gear Works.....108
Gray Co., G. A..... 34
Greaves, Klusman & Co.....111
Greenfield Machine Co.....124
Greenwald Co., I. & E.....108

Hamilton Machine Tool Co.. 91
Hammacher, Schlemmer & Co. 81
Hampden Corundum Wheel Co.124
Harrington, Son & Co., Inc., Edw..... 33
Hart Mfg. Co.....121
Hartford Steam Boiler Insp. & Ins. Co.....116
Heald Machine Co..... 93
Hendey Machine Co..... 83
Henley Publishing Co., Norman W..... 87
Henry & Wright Mfg. Co.... 92
Heppenstall Forge & Knife Co.114
Hess-Bright Mfg. Co..... 27
Hill, Clarke & Co..88, 90 and 100
Hill-Standard Mfg. Co.....125
Hilles & Jones Co..... 90
Hinckley, F. C.....112
Hisey-Wolf Machine Co..... 87
Hoefer Mfg. Co..... 14
Hoggson & Pettis Mfg. Co....120
Horton & Son Co., E.....120
Horsburgh & Scott Co..4th Cover
Hunt Co., C. W.....122
Hunt & Co., Robt. W.....112
Hurlbut-Rogers Machine Co..117
Hyatt Roller Bearing Co.... 89

Ide & Sons, A. L..... 88
Independent Pneu. Tool Co... 99
Ingersoll Milling Mach. Co...125
Ingersoll-Rand Co.... 20
International Specialty Co....124
Iroquois Machine Co..... 97

PAGE

Jacobs Mfg. Co.....120
Jacobson Mach. Mfg. Co....116
Jantz & Leist Electric Co....104
Jeffrey Mfg. Co., The..... 88
Jenkins Brothers..... 111
Johnson Machine Co., Carlyle. 30
Jones & Lamson Machine Co.
12 and 34

Keep, W. J.....110
Kelly Mach. Co., R. A..... 99
Kelsey, Duane J.....110
Kempsmith Mfg. Co..... 29
Keuffel & Esser Co.....110
Kent & Co., Edwin R.....118
King Machine Tool Co..... 97

Landis Machine Co.....110
Landis Tool Co..... 77
Lapointe Machine Tool Co... 91
Le Blond Machine Tool Co., R. K.....97 and 4th Cover
Le Count, Wm. G.....120
Link-Belt Engineering Co.....101
Lockwood, Arthur J.....119
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The...114
Lucas, J. L..... 90
Lunkenheimer Co., The.....111
Lyon Metallic Mfg. Co.....119

McBarron Co..... 93
McCabe, J. J.....88 and 106
McGlehan & Co., C. H..... 91
Manhattan Automobile School.110
Maris Bros..... 122
Marshall & Huschart Mch. Co. 89
Massachusetts Saw Works....114
Massey Machine Co.....117
Mechanical Accountant Co...111
Merrell Mfg. Co.....124
Merrill Bros..... 113
Merritt & Co.....110
Mersfelder Pattern Co..... 92
Messmer Mfg. Co., Ferd.....108
Mietz Iron Fdry & Mach. Works, August..... 116
Miner & Peck Mfg. Co.....114
Modern Tool Co.....114
Moore Co., Franklin..... 94
Morse Chain Co.....112
Morse Twist Drill & Mach. Co. 33
Morton & Co., B. K.....118
Morton Mfg. Co.....114
Motch & Merryweather Mchry. Co..... 89
Mueller Mach. Tool Co.....119
Mumford & Co., E. H..... 26
Mutual Machine Co..... 88

National-Acme Mfg. Co.....126
National Corundum Wheel Co.124
National Separator & Mch. Co.111
New Britain Machine Co.....123
New Era Gas Engine Co....116
New Haven Mfg. Co.....104
New Process Raw Hide Co....109
New Process Twist Drill Co.. 92
Newton Mach. Tool Wks., Inc. 11
Nicholson File Co..... 17
Nicholson & Co., W. H.....112
Niles-Bement-Pond Co..... ...
88, 90, 127, 128, 129 and 130
Nolte Brass Co.....119
Northern Electrical Mfg. Co..103
Northern Engineering Works..122
Norton Emery Wheel Co..... 33
Norton Grinding Co..... 16
Nuttall Co., R. D.....108
Nutter, Barnes & Co.....121

Obermayer Co., S.....119
Oil & Waste Saving Mach. Co.124
O. K. Tool Holder Co..... 91
Olds Gasoline Engine Works.116
Owen Machine Tool Co.....120

Parker Co., Chas..... 113
Patterson, Gottfried & Hunter, Ltd..... 99
Pawling & Harnischfeger.....122
Paxson Co., J. W.....122
Philadelphia Bourse.. 26
Philadelphia Gear Works.....108
Phillips & Sons Co., F. R..... 92
Phoenix Mfg .Co.....109
Poole Co., J. Morton..... 22
Phosphor Bronze Smelting Co.119
Potter & Johnston Mach. Co.. 83
Pratt Chuck Co.....120
Pratt Institute..... 92
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co... 88
Pressed Steel Mfg. Co.....111

Ransom Mfg. Co.....104
Reece Co., E. F..... 87

PAGE

Reed Mfg. Co..... 97
Reeves Pulley Co..... 27
Reichhelm & Co., E. P..4th Cover
Reliance Machine & Tool Co..110
Rich, J. & G.....110
Ridgway Dynamo & Engine Co.104
Rivett-Dock Co..... ....3d Cover
Rivett Lathe Mfg. Co....3d Cover
Robbins, L..... 124
Rogers, Boat, Gage & Drill Works, John M..... 31
Roth Bros.....104
Rowbottom Machine Co..... 92
Royersford Fdry. & Mach. Co.114

Safety Emery Wheel Co.....124
Saunders' Sons, D.....110
Sawyer Gear Works.....108
Schieren & Co., Chas. A..... 93
Schumacher & Boye..... 9
Schwerdtle Stamp Co.....118
Scranton & Co.....114
Sebastian Lathe Co..... 93
Sellers & Co., Inc., William.. 34
Seneca Falls Mfg. Co.....121
Shaw & Co.....114
Shepard Lathe Co..... 92
Shultz Belting Co..... 93
Sibley Machine Tool Co.....122
Simonds Mfg. Co.....108
Simplex Time Recorder Co.. 94
Skinner Chuck Co.....120
Slocomb Co., J. T.....100
Smith & Mills.....104
Speed Changing Pulley Co....105
Spicer Universal Joint Mfg. Co..... 114
Sprague Electric Co.....102
Springfield Machine Tool Co..107
Stafford, H. E..... 90
Standard Connecting Rod Co..116
Standard Engineering Works.122
Standard Gauge Steel Co.....121
Standard Tool Co..... 99
Stanley G. I. Elec. Mfg. Co..106
Stark Tool Co.....114
Starrett Co., L. S..... 24
Steptoe Shaper Co., John....114
Stevens, F. B.....119
Stoever Fdry. & Mfg. Co..... 92
Straley & Hasbrouck.....112
Struthers-Wells Co.... 116
Sturtevant Co., B. F..... 13
Superior Corundum Wheel Co.125
Switchboard Equipment Co...105
Syracuse Raw Hide Co.....108

Tabor Mfg. Co..... 26
Taylor-Wilson Mfg. Co.....109
Three Rivers Tool Co..... 14
Tindel-Morris Co.....117
Toomey, Frank..... 90
Triumph Electric Co.....104
Trump Brothers Machine Co.116

Underwood & Co., H. B..... 92
Union Twist Drill Co..... 85
U. S. Foundry & Sales Co....118

Vanderbeek Tool Works.....113
Vandyck Churchill Co..... 19
Vickers, Sons & Maxim.....119
Vitrified Wheel Co.....124

Wallace Supply Co.....111
Ward & Sons, Edgar T.....118
Warner Instrument Co..... 95
Warner & Swasey Co..... 77
Watson-Stillman Co.....115
Waterbury Farrel Foundry & Mach. Co..... 96
Webster & Perks Tool Co.....125
Wells Bros. Co..... 31
West Haven Mfg. Co...4th Cover
Westinghouse Elec. & Mfg. Co.103
Westmacott Co., J. M.....114
Whitcomb-Blaisdell Machine Tool Co..... 21
Whitman & Barnes Mfg. Co.... 96
Whitney Mfg. Co..... 73
Whiton Mach. Co., D. E.....120
Wiley & Russell Mfg. Co..... 26
Wiley & Sons, John..... 34
Williams & Co., J. H.....104
Wilmarth & Morman Co.....125
Windsor Machine Co.....114
Winkley Co..... 111
Wood's Sons, T. B..... 93
Woodward & Powell Planer Co..... 119
Worcester Mach. Screw Co.. 92
Wormer Machinery Co., C. C. 89
Wright, Harold A..... 92
Wyman & Gordon.....4th Cover

Yale & Towne Mfg. Co.....122

Classified Index of Articles Advertised.

Abrasive Materials

Abasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.

Abrasive Materials—*Cont'd*

National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.

Abrasive Materials—*Cont'd*

Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.

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Bartlett, E. E., Boston, Mass.
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Dodge & Day, Philadelphia, Pa.

Auctioneers
Shaw & Co., New York.

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Standard Roller Bearing Co., Philadelphia, Pa.

Ball Bearings
See Roller Bearings.

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Elmes Engineering Works, Chas. F., Chicago, Ill.
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Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Bars, Boring Cylinder
Underwood & Co., H. B., Philadelphia, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

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Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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Prentiss Tool & Supply Co., New York.
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Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

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Wallace Supply Co., Chicago, Ill.

Bicycle Parts
Standard Welding Co., Cleveland, Ohio.

Blocks, Chain
See Hoists, Hand.

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Chicago Flexible Shaft Co., Chicago, Ill.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
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Keuffel & Esser Co., New York.

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Struthers-Wells Co., Warren, Pa.

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Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., Easthampton, Conn.
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Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Wiley & Sons, Jno., New York.

Boosters
Burke Electric Co., Erie, Pa.
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.

Boring and Turning Mills *Continued*
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Boxes, Tote
Lyon Metallic Mfg. Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Broaching Presses
Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Bulldozers
Prentiss Tool & Supply Co., New York.
Williams, White & Co., Moline, Ill.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Athol Machine Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Brass and Bronze
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cornell Co., J. B. & J. M., New York.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartfrod, Ct.

Chemists
Booth, Wm. M., Syracuse, N. Y.

Chisels, Cold
Anderson & Sons Co., Detroit, Mich.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Oneida National Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Oneida National Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Mchry. Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
International Steam Pump Co., New York.
Ingersoll-Rand Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
McGlehan & Co., C. H., New York.

Controllers and Starters Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold A., New York.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N.Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co, Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mach. Co., Bridgeton, N. J.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Beskine Mfg. Co., Canton, O.
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Multiple Spindle—*Continued*
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

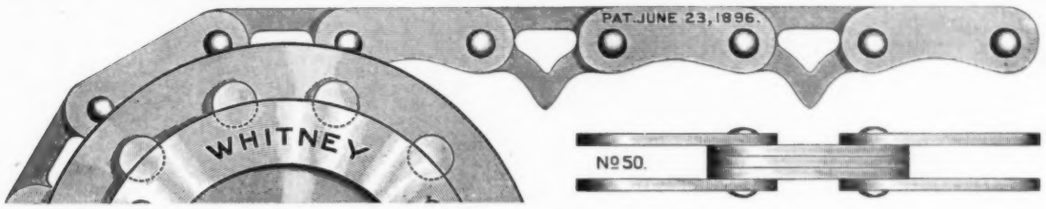
Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Hamilton Mach. Tool Co., Hamilton, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

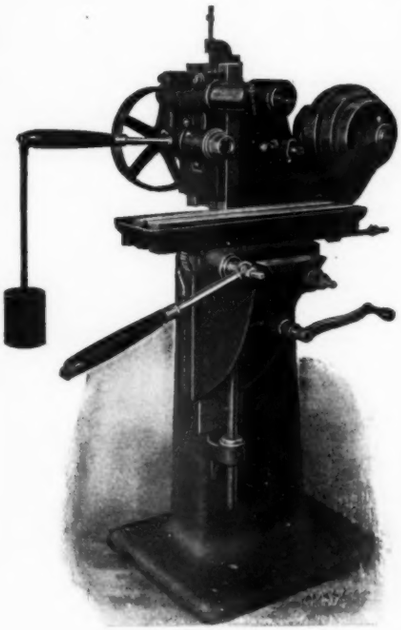
Drills, Center
Morse Twist Drill & Mach Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

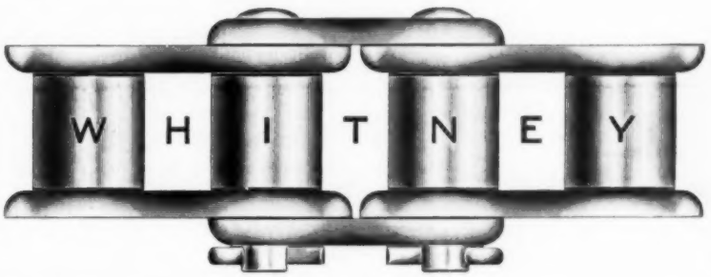
Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

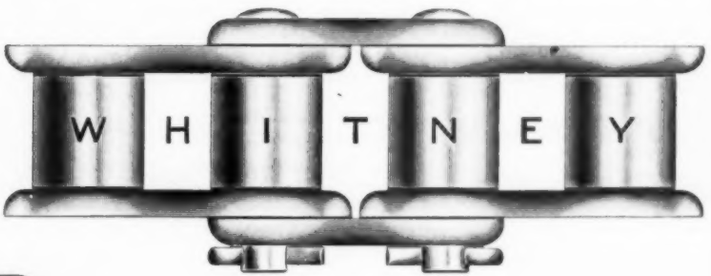


"WIZARD" Chains and Sprockets—Patented

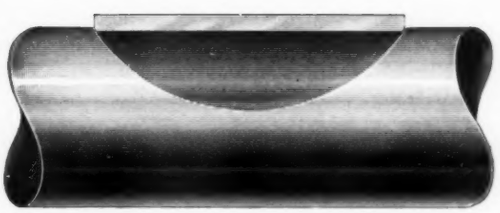




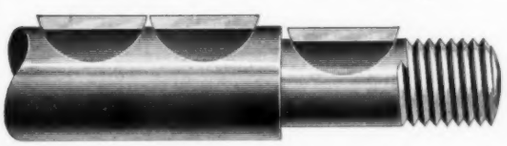
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal

Drills, Radial
Hamilton Mach. Tool Co., Hamilton, O.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Clark, Jr., & Co., Jas., Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. A., Wilkesbarre, Pa.

Extractors
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadephia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.

Gear Cutting Machinery *Continued*
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwad Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

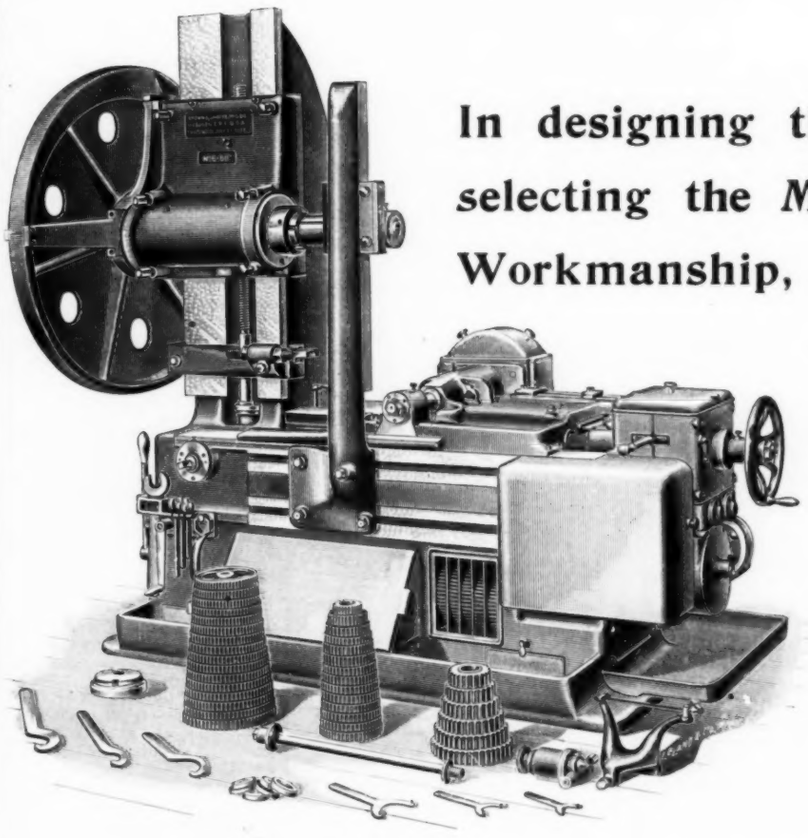
BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

A FEATURE OF THE

B. & S. Automatic Gear Cutting Machines

IS THEIR ACCURACY



In designing the Machines, in selecting the Material, and in Workmanship, two ideas have been constant:

Durability

and

Reliability

Twenty-five Years' Experience In Their Use and Manufacture Is Embodied In Their Construction.

MADE IN 9 SIZES

CIRCULARS, WITH FULL SPECIFICATIONS OF ALL MACHINES, MAILED FREE TO ANY ADDRESS.

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Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
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Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Grinders, Tool—*Continued*
Barnes Co., W. F. & John, Rockford, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & Jno., Rockford Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneu. Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Il.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Mchy. Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
International Steam Pump Co., New York.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel
Sprague Elec. Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

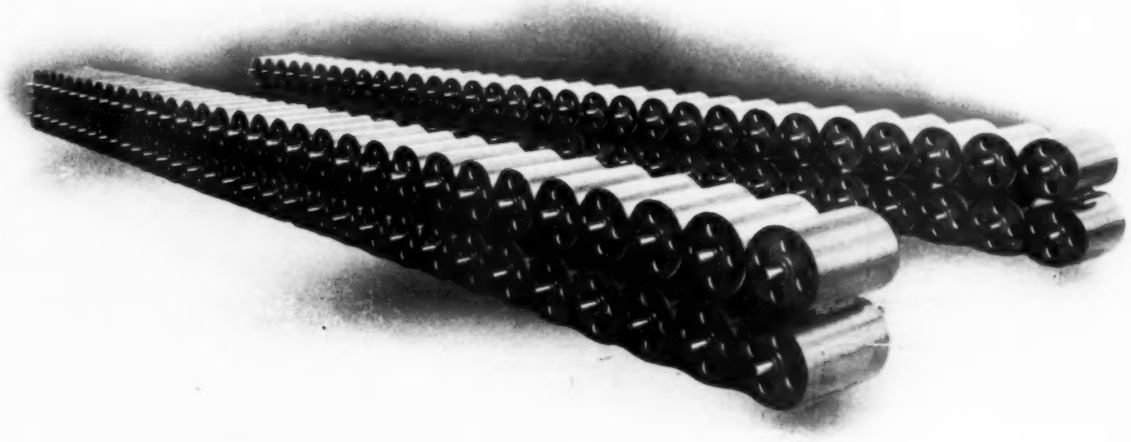
Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear
Phillips & Sons Co., F. R., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

The Landis Way of Grinding

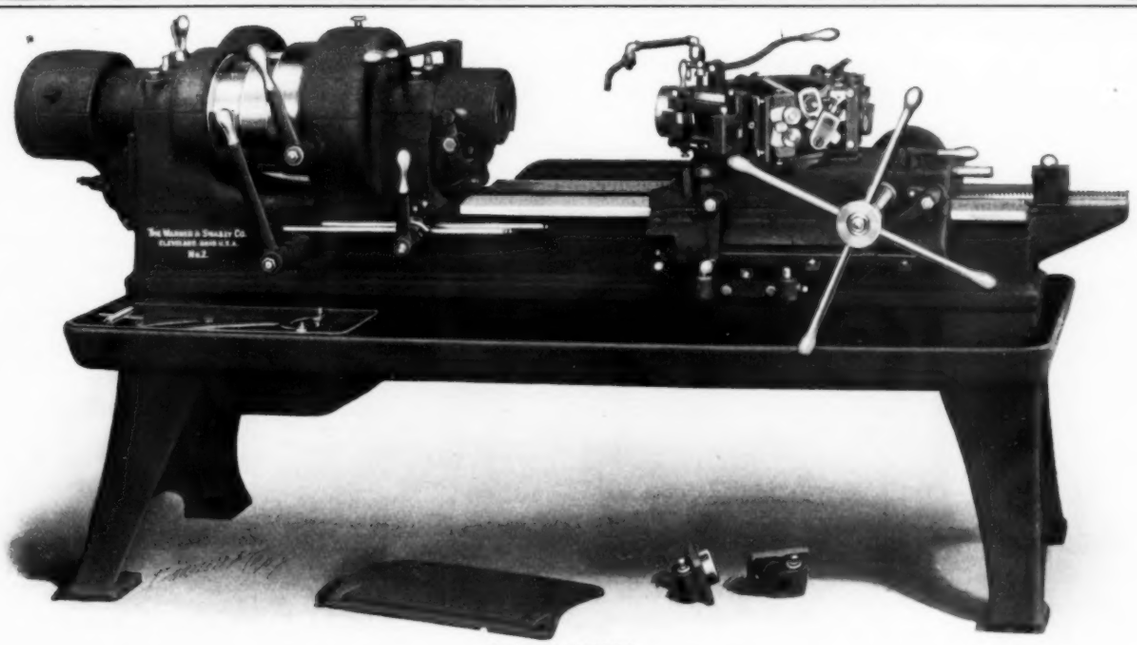


128 Cast Iron Printing Press Rolls

12" diameter, 18" long. Ground to a first class commercial finish, 3-64" diameter, removed, average time 15 minutes. This is just one of the many similar examples and records of production of our manufacturing Grinding Machines. We are Grinding Specialists. Send us blue prints and let us submit an estimate on your work—we can show you interesting figures in cost reduction.

Landis Tool Company, Waynesboro, Pa., U. S. A.

AGENTS—W. E. Flanders, 309 Scofield Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty Street, New York, N. Y. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris, Barcelona and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Can.



No. 2 MACHINE.

Hollow Hexagon Turret Lathes

THREE SIZES:
No. 1—1⅜ x 15, No. 2—2¼ x 24, No. 3—3⅝ x 36"

FOR RAPID PRODUCTION

THE WARNER & SWASEY CO.

CLEVELAND, OHIO, U.S.A.

TURRET LATHES SCREW MACHINES
BRASS WORKING TOOLS

FOREIGN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg and Glasgow. Alfred H. Schutte, Cologne, Paris, Brussels and Milan. H. W. Petrie, Toronto. Williams & Wilson, Montreal.

Lamps, Incandescent
General Electric Co., New York.
Gilmore Elec. Co., So. Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Hamilton Mach. Tool Co., Hamilton, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.

Lathes, Bench—*Continued*
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Wood
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., New York.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locks
Yale & Towne Mfg. Co., New York.

Locomotives, Electric
General Electric Co., New York.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Frasse Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Le Count, Wm. G., So. Norwalk, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.

Machinists' Small Tools
Continued
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Machinists' Supplies
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Frasse Co., Peter A., New York.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Manufacturing Specialties
Stafford, H. E., Providence, R. I.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Advance Mfg. Co., Kalamazoo, Mich.
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Meters, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mch. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.

Milling Machines, Horizontal—*Continued*
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Rand Co., New York.

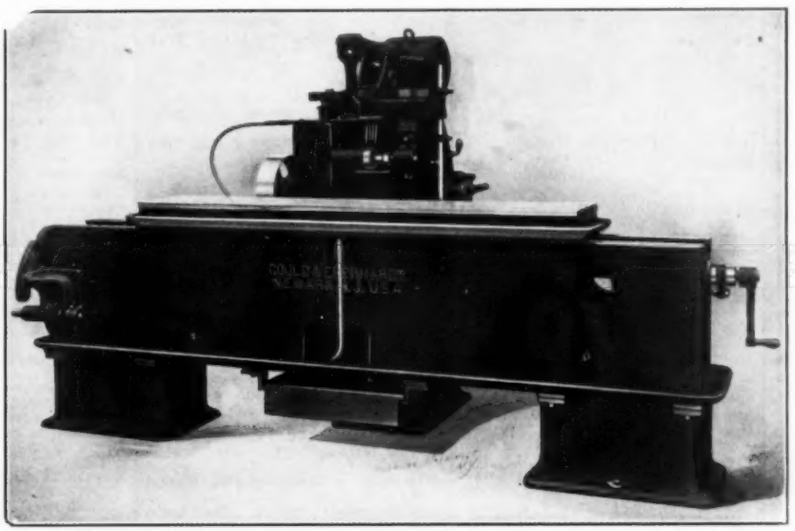
Mixing and Sifting Machines, Sand
Gould & Eberhardt, Newark, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Mumford Co., E. H., Phila., Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Automatic Rack Cutting Machines

Made in capacities to cut from 6 to 10 feet at one setting, in both light and heavy patterns. These machines are designed and intended for the use of manufacturers of machine tools, printing presses, etc., requiring accurate racks. NOTE—We have a 10-foot Heavy Pattern Machine on hand for prompt delivery.

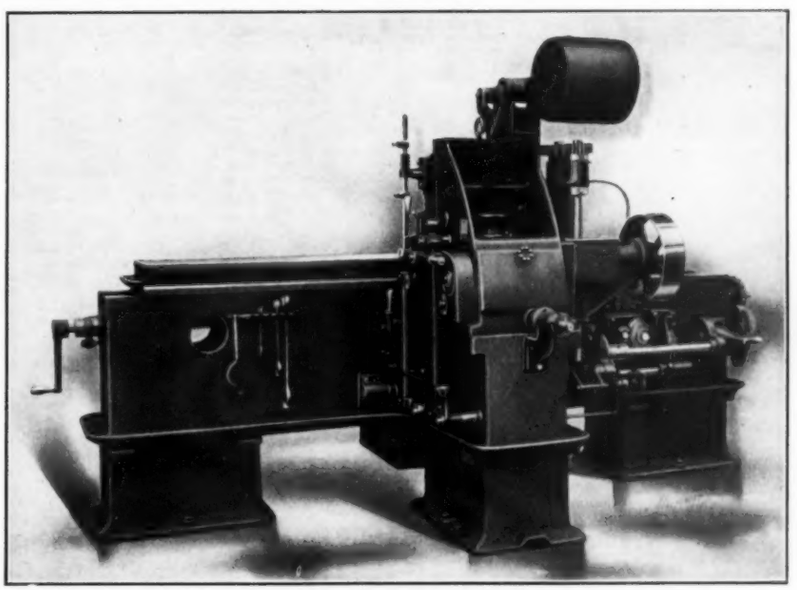
Six Foot Medium Pattern



FRONT VIEW

We have a well equipped Gear and Rack Cutting Department. Spiral Gears cut up to 72" diameter. Worm Wheels generated theoretically correct, with or without a hob

Send in your specifications



BACK VIEW

GOULD & EBERHARDT, Newark, N. J., U.S.A.

Designers and Builders of High Class Machine Tools

SELLING AGENTS—Prentiss Tool & Supply Co., New York, Boston and Buffalo. Baird Machinery Co., Pittsburg, Pa. Marshall & Huschart Machinery Co., Chicago. Motch & Merryweather Machinery Co., Cleveland. The Fairbanks Co., Philadelphia and Baltimore. Henshaw, Bulkley & Co., San Francisco. Hallidie Machinery Co., Seattle. W. R. Colcord Machinery Co., St. Louis. C. T. Patterson Co., New Orleans.

FOREIGN AGENTS—Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Selig Sonnenthal & Co., London, England. Adolfo B. Horn, Havana, Cuba. F. W. Horne, Yokohama, Japan.

Molds, Hammer and Vise Jaw

Field, Chas. H., Providence, R. I.

Mortising Machines, Chain

New Britain Mach. Co., New Britain, Conn.

Motors, Electric

Burke Elec. Co., Erie, Pa.
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Jantz & Leist Elec. Co., Cin., O.
Northern Electric Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Name Plates

Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers

See Bolt and Nut Machinery.

Oil and Waste Saving Machine

Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Oil Stones

Norton Emery Wheel Co., Worcester, Mass.

Packing, Metallic

Advance Mfg. Co., Kalamazoo, Mich.

Packing, Steam

Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic

Watson-Stillman Co., New York.

Paints and Enamels, Machinery

Felton, Sibley & Co., Phila., Pa.

Pans, Lathe

Lyon Metallic Mfg. Co., Chicago, Ill.
New Britain Mach. Co., New Britain, Conn.

Pans, Shop

Lyon Metallic Mfg. Co., Chicago, Ill.

Patents

Hinckley, F. C., New York.
Straley & Hasbrouck, New York.

Patterns and Models

Mersfelder Pattern Co., Cin., O.

Pattern Shop Machinery and Supplies

Baker Bros., Toledo, O.
Blount Co., J. G., Everett, Mass.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Pencils

Dixon Crucible Co., Jos., Jersey City, N. J.

Phosphor Bronze

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pinion Cutters

American Watch Tool Co., Waltham, Mass.
Gould & Eberhardt, Newark, N. J.

Pipe Cutting and Threading Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.

Pipe Cutting and Threading Machines—*Continued*

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Standard Engineering Works, Ellwood City, Pa.
Stoever Fdry. & Mfg. Co., Myerstown, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer Attachments

Cincinnati Planer Co., Cincin., O.
Gray Co., G. A., Cincinnati, O.

Planers

American Tool Wks. Co., Cin., O.
Bartlett, E. E., Boston, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bilgram, Hugo, Philadelphia, Pa.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Hamilton Mach. Tool Co., Hamilton, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable

Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Precision Machinery

American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Drop

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

Presses, Forging

Niles-Bement-Pond Co., New York.

Presses, Hand

Bliss Co., E. W., Brooklyn, N. Y.

Presses, Hydraulic

Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Watson-Stillman Co., New York.

Presses, Power

American Tube & Stamping Co., Bridgeport, Conn.
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.

Presses, Power—*Continued*

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Fairbanks Co., New York.
Lucas Mach. Tool Co., Cleve., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Screw

Barnes Co., W. F. & Jno., Rockford, Ill.

Profilers

American Watch Tool Co., Waltham, Mass.
Becker-Brainard Mill. Mach. Co., Hyde Park, Mass.
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Publishers

Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.

Pulleys

American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Mchy. Co., New Haven, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.
Wood's Sons, T. B., Chambersburg, Pa.

Pulley Turning and Boring Machines

American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Pumps, Air

Ingersoll-Rand Co., New York.

Pumps, Electric

General Electric Co., New York.

Pumps, Hydraulic

Elmes Engineering Works, Chas. F., Chicago, Ill.
General Electric Co., New York.
Watson-Stillman Co., New York.

Pumps, Steam

Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.

Punches, Centering

Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.

Punches, Hand

Whitman & Barnes Mfg. Co., Chicago, Ill.

Punches, Hydraulic

Bethlehem Fdry. Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Punches, Power

Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Vandyck Churchill Co., New York.

Rack Cutting Machines

Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.

Rack Cutting Machines—*Continued*

Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Racks, Cut

Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Racks, Tool

Lyon Metallic Mfg. Co., Chicago, Ill.
Massey Mach. Co., Watertown, N. Y.
New Britain Mch. Co., New Britain, Conn.

Radiators, Japanning Oven

American Gas Furnace Co., New York.

Reamers

Boker & Co., Hermann, New York.
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Lapointe Mach. Tool Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
Wells Bros. Co., Greenfield, Mass.
Whitman-Barnes Mfg. Co., Chicago, Ill.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Regulators, Voltage

Gilmore Electric Co., South Boston, Mass.

Reheaters, Steam

Ingersoll-Rand Co., New York.

Rheostats

Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Rims and Bands

Standard Welding Co., Cleve., O.

Rings, Chuck and Gear

Standard Welding Co., Cleve., O.

Riveters, Hydraulic

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic

Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Riveters, Steam

Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines

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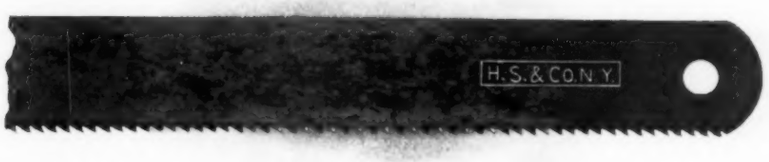

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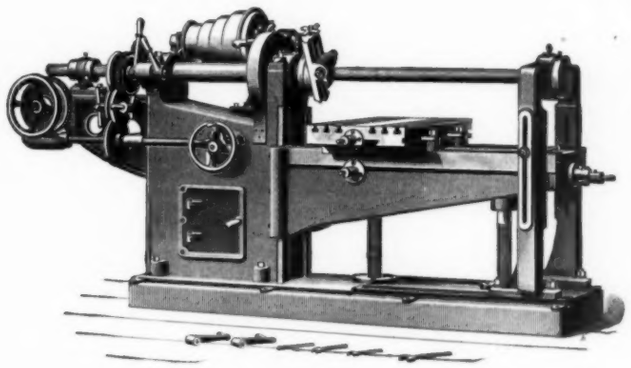

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Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Pressed Steel Mfg. Co., Philadelphia, Pa.
Standard Roller Bearing Co., Philadelphia, Pa.

Roller Mills, Coining
Dill Mach. Works, T. C., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Mach. Works, T. C., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Athol Machine Co., Athol, Mass.
Billings & Spencer Co., Hartford, Conn.
Hammacher, Schlemmer & Co., New York.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Sand Blast Apparatus
Drucklieb, C., New York.
Paxson Co, J. W., Philadel., Pa.

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Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Saw Sharpening Machines
Cochrane-Bly Co., New York.
Nutter, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cochrane-Bly Co., Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Saws, Hack Power
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Saws, Metal Band
Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
American School of Correspondence, Chicago, Ill.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Manhattan Automobile School, New York.
Pratt Institute, Brooklyn, N. Y.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.

Screw Machines, Automatic *Continued*
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mach. Co., Chicago, Ill.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Reece Co., E. F., Greenfield, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Screws, Cap and Set
Cleveland Cap Screw Co., Cleveland, O.
National Acme Mfg. Co., Cleveland, O.

Screws, Machine
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Standard Gauge Steel Co., Beaver Falls, Pa.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Ide & Son, A. L., Springfield, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Mchry. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Cresson Co., Geo. V., Phila., Pa.
General Electric Co., New York.

Separators, Oil and Steam
National Separator & Mach. Co., Concord, N. H.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Shafting
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Pressed Steel Mfg. Co., Philadelphia, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.

Shafting—*Continued*
Wood's Sons, T. B., Chambersburg, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Cochrane-Bly Co., Rochester, N. Y.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hamilton Mach. Tool Co., Hamilton, O.
Hendey Mach. Co., Torrington, Ct.
Kelly Mach. Co., R. A., Xenia, O.
Marshall & Huschart Mach. Co., Chicago, Ill.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Shepard Lathe Co., Cincinnati, O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cin., O.
Vandyck Churchill Co., New York.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmintgon, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Shears, Rotary
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.

Sheet Metal Working Machinery
Bartlett, E. E., Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Swaine Co., Fred J., St. Louis, Mo.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bartlett, E. E., Boston, Mass.
Betts Mach. Co., Wilmington, Del.
Blount Co., J. G., Everett, Mass.
Garvin Mach. Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Slotters
Baker Bros., Toledo, O.
Betts Machine Co., Wilmington, Del.
Dill Mach. Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
National-Acme Mfg. Co., Cleve., O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Sockets and Sleeves
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Standard Tool Co., Cleveland, O.

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Automatic Mach. Co., Bridgeport, Conn.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Cleveland Cap Screw Co., Cleveland, O.
Crescent Forgings Co., Oakmont, Pa.
Dallett Co., Thos. H., Phila., Pa.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
General Mfg. Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mach. Tool Co., Cleveland, Ohio.
McGlehan & Co., C. H., New York.
Massey Mach. Co., Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mueller Mach. Tool Co., Cin., O.
National-Acme Mfg. Co., Cleveland, O.
Nutter, Barnes & Co., Boston, Mass.
Poole Co., J. Morton, Wilmington, Del.
Pratt & Whitney Co., Hartford, Conn.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Engineering Works, Ellwood City, Ind.
Three Rivers Tool Co., Three Rivers, Mich.

Spools, Steel
Standard Welding Co., Cleve., O.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Link-Belt Engineering Co., Philadelphia, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Whitney Mfg. Co., Hartford, Ct.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

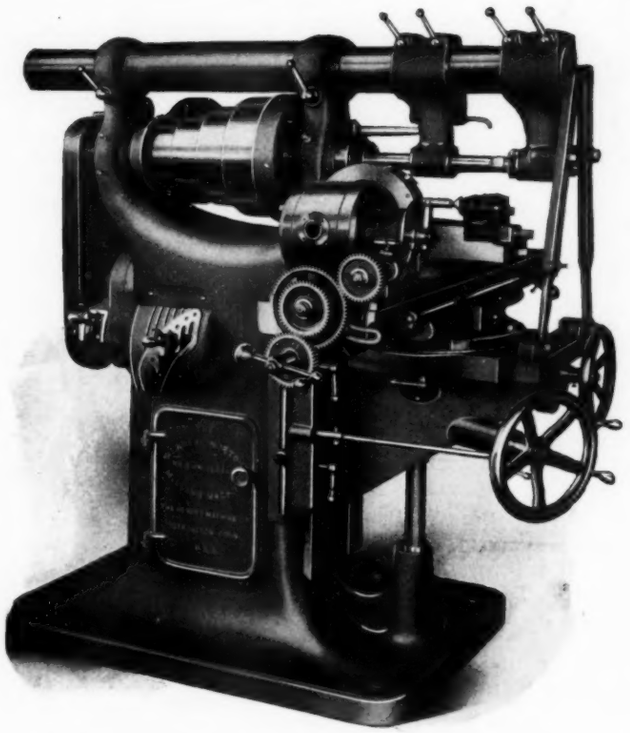
Steam Specialties
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse Co., Peter A., New York.
Kent & Co., Edwin R., Chicago, Ill.
Lockwood, Arthur J., New York.
McInnes Steel Co., Corry, Pa.
Morton & Co., B. K., Toronto, Canada.
Standard Gauge Steel Co., Beaver Falls, Pa.
Vickers, Sons & Maxim, Sheffield, England.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse Co., Peter A., New York.
Kent & Co., Edwin R., Chicago, Ill.
Lockwood, Arthur J., New York.
McBarron Co., Boston, Mass.

The Hendey-Norton No. 3 Universal Miller.



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Main Spindle and Bearing Construction identical with that of our Lathe Heads, Bearings being Annular and Journals of Spindle Taper, with Ring Oiling System, giving better and more durable service than any other form.

Practical features these machines have always had, are: Projected Bearing of Knee on Column, well above saddle seat, insuring more rigid support to table under working strains.

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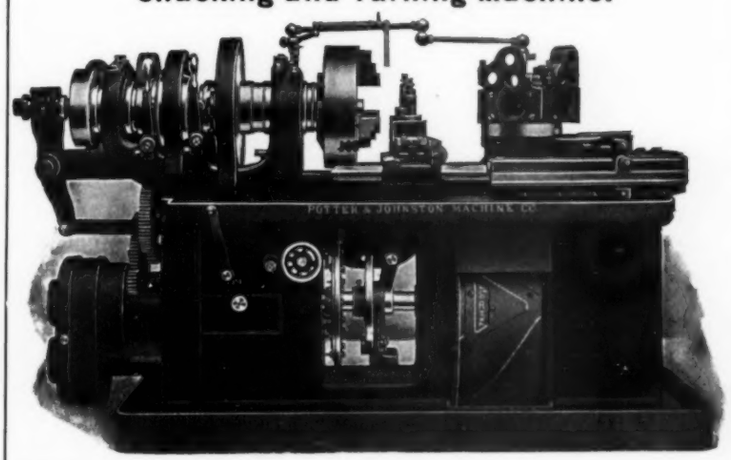

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Bullard Automatic Wrench Co., Providence, R. I.
Williams & Co., J. H., Brooklyn, N. Y.

The Differential Band Brake.

EDITORIAL CORRESPONDENCE.

The differential brake has been extensively used in England and Germany, but in this country very few seem to be familiar with it, this lack of familiarity going so far that some attempts to apply it have proven failures because its principle was not correctly grasped. The brake is regularly applied to the hoisting engines made by the F. M. Davis Iron Works Company, of Denver, Colo., for whom its leading dimensions were worked out by the late Henry A. Vezin. By the courtesy of the Davis works I am permitted to give a table which embodies the results of Mr. Vezin's analysis.

The brake may be made to assume several forms, of which perhaps the simplest is shown in Fig. 1, which illustrates the usual form as applied at the Davis works. Whatever its form may be, the principle is the same, that principle being that the end of the brake strap which is usually fixed to the framework of the hoist shall here be attached to an arm keyed to the shaft by which the other end is tightened, the result being that the tensile strains on the two ends of the strap oppose one another, the tension on the end which is usually fixed serving to assist the operator in applying the brake.

Referring to Fig. 1, *a* represents the weight to be lifted by the rope drum *b*. tached to the frame, the application of the brake being made by tightening *e*, which is attached for that purpose to the end *f* of a bell crank which is operated by the

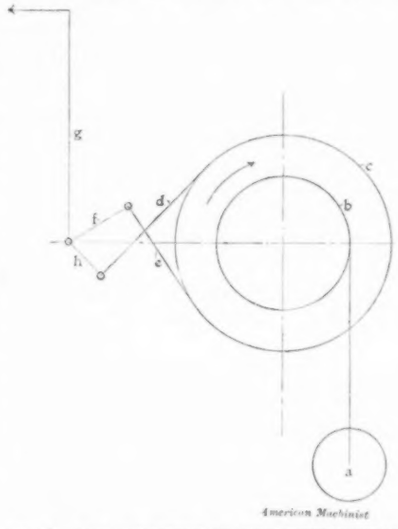


FIG. 1. THE PRINCIPLE OF THE DIFFERENTIAL BRAKE.

brake lever *g*. With the differential brake, however, the end *d* is attached to an additional arm *h* of the bell crank, the action being that the tension in *d* tends to tighten

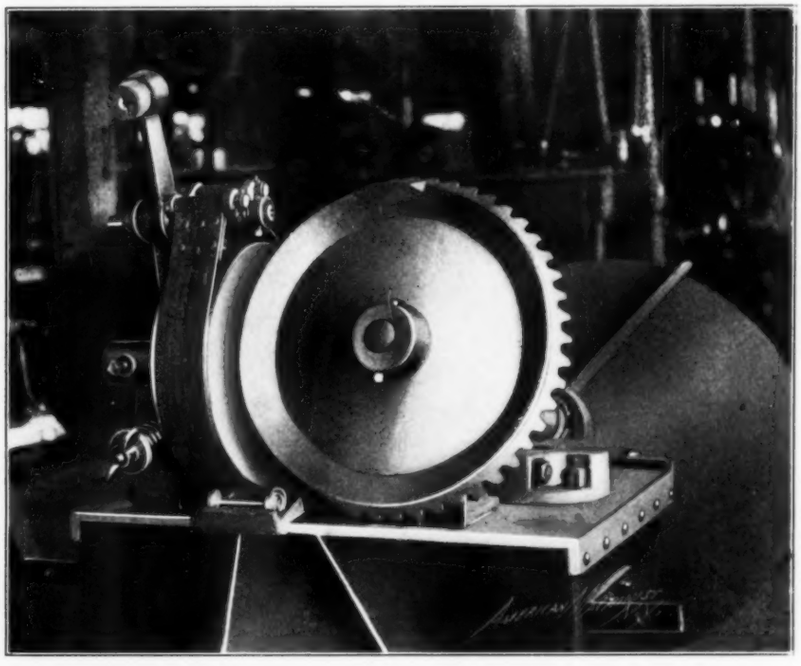


FIG. 2. APPLICATION OF THE PRINCIPLE OF THE DIFFERENTIAL BRAKE TO AN AUTOMATIC ORE FEEDER.

At *c* is the brake drum, the ends of the brake strap being at *d* and *e*. The direction of motion when lowering the load being that shown by the arrow, it follows that the end *d* of the strap carries the load and it is this end which is commonly at- *e* and thus apply the brake. In order that the strap may be tightened at all it is obviously necessary that the arm *h* be shorter than *f* and it is on the ratio between these arms that the design hinges.

The two ends of the brake strap are, of course, under the same conditions as the slack and the tight sides of a belt, and the ratio of the strains in them may be determined by the well-known fundamental belt formula, this ratio depending on the arc of contact of the strap and on the coefficient of friction between the brake blocks and the drum. It is obvious that if the strain on *d* be, for example, twice that on *e*, and if the length of *h* be slightly more than half that of *f*, the brake will apply itself when the drum is released from the engine which hoisted the load, and if the load is to be lowered at all the brake must be released by hand. On the other hand, if the length of *h* be slightly less than half of *f* the brake will not apply itself, the action of the tension on *d* serving merely to reduce the pressure which must be applied to *g* in order to hold the load. Both these conditions are employed in the Davis hoists, the former in small and the latter in large ones.

The table, which is by Mr. Vezin, gives the ratios which the arms *f* and *h* must bear to each other in order to give the limiting condition between those described; that is, in order that the brake may be self applying, the arm *h* must be slightly longer, and in order that it may need help applied to lever *g*, it must be slightly shorter than the figures given by the table.

Fig. 2 shows a recent application of the principle of the differential brake to driving instead of braking mechanism, which has been applied recently at the Davis works. The application is to the automatic feeder of a stamp mill, the device as here applied being essentially a friction ratchet and pawl.

In stamp mills it is desirable to have a certain depth of material in the stamp battery with provision to add fresh material as the crushing goes on, the gage being

Fraction of Circumference Embraced by Brake Strap.	Value of Coefficient of Friction.			
	.18	.28	.33	.47
	Ratio Between Arms.			
.5	1.76	2.41	2.82	4.38
.6	1.97	2.87	3.47	5.88
.7	2.21	3.43	4.27	7.90
.8	2.47	4.09	5.25	10.62

TABLE FOR LAYING OUT DIFFERENTIAL BRAKES.

the point to which the stamp head drops. The plate shown in the background of Fig. 2 lies, in the actual machine, in a horizontal direction though nearly vertical in the picture. It receives the ore from a chute which does not touch its surface and by its turning under the chute the ore is scraped off into the battery by the scraper plainly shown. The amount of this turning plainly determines the amount of ore fed into the battery, and this turning is, in turn, determined by the descent of the stamp head, which, if it reaches the point at which more ore is required, hits

the rubber block on the end of the arm which is nearly vertical in the picture. This arm is pivoted on a second arm which swings about the same center as the drum about which the strap passes. The pivot bolt of the first arm carries two arms which are laid out precisely as are the two arms *d h* of Fig. 1. The initial action is to swing these arms about their pivot and tighten the band, further movement being accompanied by the turning of the drum and through the gearing, partly shown, of the ore feed table. A spring coiled on the fulcrum pin of the first arm insures its return to its initial position when the stamp head ascends. This fulcrum pin has also an eccentric mounting for taking up wear of this band. The proportions of the arms are of course those of a self-acting brake. F. A. H.

The New York municipal lighting plant was recently started with rubbish and refuse as a fuel basis. There are three Burke generators, each of 150-kilowatts, driven by three Ideal engines of 150 horse-power each. The current is used for lighting the Williamsburg Bridge, in place of the former Edison service, and a considerable saving is expected.

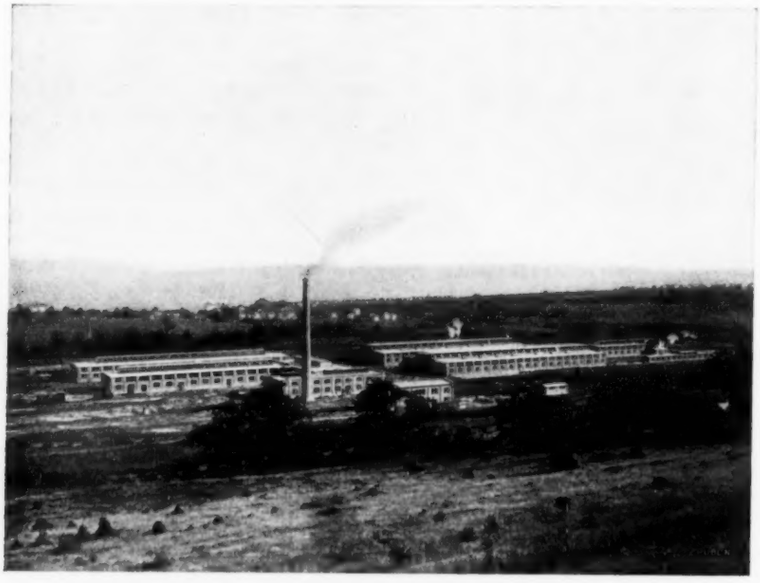


FIG. 1. KEYSER VALLEY SHOPS OF THE D., L. & W. R. R. CO.

FIG. 2. LAYING CONDUITS IN ENGINE ROOM.

The Electrical Equipment of the D., L. & W. R. R. Shops at Keyser Valley, Pa.

The Delaware, Lackawanna & Western Railroad Company has recently completed, at a cost of $1,250,000, some extensive shops at Keyser Valley, near Scranton, Pa., in order to take care of the freight equipment of the road, both as regards repairs and new work. A general view of the plant is given in Fig. 1, the other illustrations showing interior views. There is a total of nine large buildings, of brick and steel construction, the floor space aggregating six acres, of which five are in cement. The power plant is strictly modern, motor-driven coal and ash handling machinery being provided. The generating station apparatus, which, with all the electric installation, has been supplied by the General Electric Company, comprises one 100-kilowatt and two 300-kilowatt, three-phase, 60-cycle, 480-volt generators,

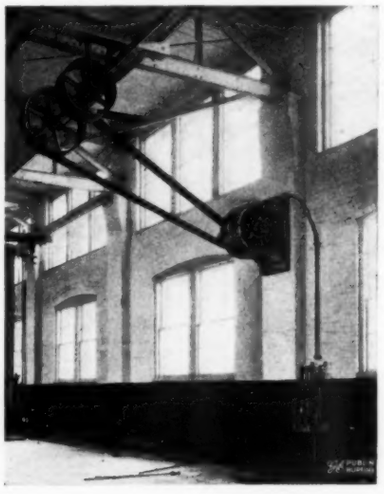


FIG. 4. MOTOR APPLICATION.

each direct driven by a Ball & Wood engine; one 30-kilowatt exciter, direct driven by a Ball & Wood engine, and one 30-kilowatt motor-driven exciter.

Power is conveyed from the generating station to the various shops by lead-covered cables laid in underground terra-cotta ducts. Suitable distribution cabinets,

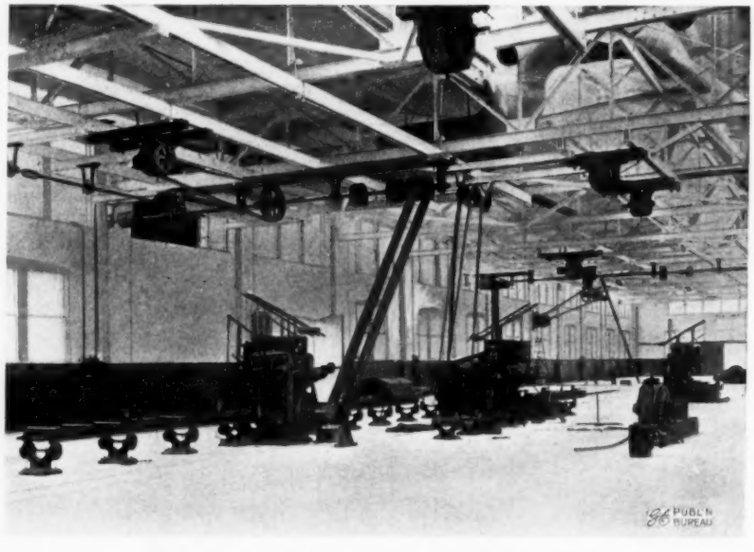


FIG. 3. MOTOR APPLICATIONS IN PLANING MILL.

to which the supply mains and motor and lighting feeders are brought, are placed in each building, thereby providing a great number of lighting and power circuit combinations to meet changes in arrangement of tools, etc. The wiring is carried in loricated metal tubes of various sizes, laid in the cement floors, the method of laying being shown in Fig. 2.

General Electric form "K" 440-volt in-

duction motors are used throughout, the accompanying tables giving the details of the various drives. The figures of the column headed "H.P. Computed" were obtained from the well-known belt formula:

H.-P. = speed of belt in feet per minute × width of belt in inches ÷ 950.

The individual drives are all belt-connected, with the exception of one gear drive, and the group drives are all belt-connected, with the exception of two chain drives. Figs. 3 and 4 illustrate the way in which the motors are installed in out-of-the-way locations, on the wall or floor, or overhead.

Additional motors, not given in the tables, drive the fans for the heating and ventilating system, the shavings exhaust from the planing mill and the smith shop blowers.

Table 4 gives the lighting scheme, which will be seen to include both arc and incandescent lamps, and which has proven to be exceptionally satisfactory.

Tool.	Make.	Pulley, Inches.	Belt, Inches.	R. P. M.	Method of Drive.	H. P., Computed.	H. P. Motor.
Punch and shear	Hilles & Jones, No. 0	36	4½	240	Group	3	3.0
Belt hammer	Bradley	18	5	310	"	7.6	5.0
Punch and shear	Long & Allstatter, No. B	30	5½	180	"	8.2	15.0
Bolt header, 1-inch	Ajax Manufacturing Co	46	6	90 to 100	"	5	5.0
Alligator shears	D., L. & W. R. R	18	7½	200	"	7.5	5.0
Bulldozer	Ajax Manufacturing Co., No. 7	36	6	450	Individual	26	15.0
Belt hammer	Bradley	18	5	310	Group	7.6	5.0
Blakeslee bolt header	Ajax manufacturing Co., 2⅛-inch	40	8	200	"	17.7	10.0
Punch and shear, new	Long & Allstatter, No. D	..	..	...	Individual	20	20.0
Old bolt header, 1-inch bolts		35½	5½	100	Group	5	5.0
Forging machine, 2⅛-inch, old	Ajax Manufacturing Co	40	10	225	"	24.7	10.0
Eye bending machine	Williams & White Co	20	2	280	"	5	5.0
Jointer		..	..	...		0.5	.5
Bulldozer, new	Williams & White Co	30	10	240	Group	7.5	7.5
Small punch	Now in machine shop	15	8	93	"	5	5.0

Aggregate computed H. P., 150.3.
Corresponding aggregate in H. P. of motors installed, 116.

TABLE I.—MOTOR DRIVES IN SMITH SHOP.

Tool.	Make.	Pulley, Inches.	Belt, Inches.	R. P. M.	Method of Drive.	H. P., Computed.	H. P., Motor.
Hydraulic wheel press for pressing off	D., L. & W. R. R	24	8	172	Group	9.98	5
Hydraulic wheel press for pressing on	D., L. & W. R. R	24	8	172	"	9.98	5
Niles boring mill for car wheels	Niles Tool Co	16	5	90	"	1.98	3
Boring mill for wheels, new	Putnam & Co	22	5	135	"	3.94	7½
Wheel boring mill	Bement & Co., No. 232	16	4	135	"	2.38	3
Axle centering machine	D., L. & W. R. R	9	4	283	"	3.00	3
Lathe for 36-inch steel tired wheels	Bennett & Son	18	5	90	"	2.23	7½
Emery grinder	D., L. & W. R. R	6¾	3	1,100	"	5.97	2
Small lathe, 7-inch swing	D., L. & W. R. R	5½	2	540	"	1.56	1
Gang drill	Bement & Co	20	3½	175	"	3.37	7½
Axle lathe, single head	Bennett & Son	17	4	150	"	2.81	5
Double headed axle lathe	Putnam & Co	26	5	194	"	6.5	10
Fox lathe, 7-inch swing		3½	1½	557	"	.93	1
Drill	New York Steam Engine Co., 1867	12	2½	250	"	2.66	3
Barnes drill	Barnes & Co	10	3	262	"	2.16	3
Pond lathe, 30-inch swing	Pond & Co	17½	3½	65	"	1.81	5
Double headed shaper	Niles Tool Co	18	3½	120	"	2.83	6
Prentice drill	Prentice Bros	12	3	220	"	2.13	2
Long lathe, 15-foot	Scrapped	12	2½	20			3
Bement drill press, No. 7o7	Bement & Son	8	2½	246	Group	1.35	2
Small lathe, 10 foot	Stover Machine Co., scrapped	8	2½	100			2
Planer, 36-inch	Cincinnati planer	28	5	170	Group	6.50	10
Pipe cutter		12	3½	200	"	2.31	2
Twist drill grinder	American Twist Drill Co	3	1½	1,665	"	2.64	2½
Small bench drill	D., L. & W. R. R	6	2	208	"	.70	1
Grinder for mine car seats	D., L. & W. R. R	4	2½	1,600	"	4.10	2
D. H. bolt cutter, 1-foot 2 inch	National Machine Co	12½	3	229	"	2.31	3
Double bolt cutter	National Machine Co	12½	3	229	"	2.31	3
Double bolt cutter	National Machine Co	12½	3	229	"	2.31	3
Double bolt cutter	National Machine Co	12½	3	229	"	2.31	3
Double bolt cutter, new	National Machine Co	12½	3	190	"	1.96	3
18-foot lathe, 24 inch (new)	Niles Tool Works				"		3
Large drill, old	From Dover shop				Individual		5
Two-spindle bolt cutter, new		12½	3	190	Group	1.96	5
Nut tapping machine, large, new	Six-spindle	16	4	175	"	3.99	5
Nut tapping machine, small, new	Six-spindle	16	4	175	"	3.99	3
13-inch tool room lathe, new	Pratt & Whitney	14	2½	610	"	.62	3
Grinding machine, new	Bridgeport	8	4	656	"	5.78	5
Grindstone, new					"		1
Double bolt cutter, old		12	3	229	"	2.31	1
New lathe, 20 inch	Hendey & Norton				"		3
Slotter, new	Niles Tool Works	16	2½	75	"	.81	3
Milling machine, Universal, new	Cincinnati				"		3
Gisholt tool grinder					"		1
Double head axle lathe, new	Putnam & Co	26	5½	194	"	7.99	7½
Double head axle lathe, new	Putnam & Co	26	5½	194	"	7.99	7½
Drill in tool room					"		
Small drill (in B. S. shop)		14	3½	200	"	2.70	3
Large drill (in B. S. shop)					Individual		5
Hydraulic press (Schafer)	Manning, Maxwell & Moore				Group		5
Gang drill, 8 spindles	Bickford Drill & Tool Co				"		7½

Aggregate computed H. P., not including the twelve tools for which no figures are given, 133.61.
Corresponding aggregate in H. P. of motors installed, 159¾.

TABLE 2.—MOTOR DRIVES IN MACHINE SHOPS.

Echoes From the Oil Country—Another Reason for Hard Castings.

There may be various ways of thinking about what it is that really makes success in life, and most of us who have passed well along over the first part of the path of life may sometimes be inclined to admit that there is such a thing as being too strenuous in the pursuit of some one line to the neglect of general enjoyment, and to envy the man who is contented with his lot and position in life, or at least enough so that he does not think it worth while to try to fit himself for anything better.

While this is so, at the same time it is sometimes hard to understand how some people can be around so long and get to be expert in some one mechanical line and yet know so little in a general way about things.

Charley was a good lathe hand. He had been at the business long enough to be rated as a machinist before he came to work in the shop where he now is, and he seemed to be a man of good average intelligence. One day he was turning up some piston rings, and the casting was very hard, and he was having trouble to cut it, when one of the other men came by his lathe.

"My, but this is a hard piece of iron," said Charley, "what do you think is the matter with it that it is so hard to cut? Don't you think they must have got some steel or something in it in the foundry? I never had any castings like this when they got their castings from King."

The other machinist did not know a bit more about why the iron was hard than Charley did, but as his opinion had been asked he felt called upon to give an answer, so after looking at the casting critically for a minute or two he said: "I'll tell you what must be the matter. The molder that made that casting rammed his sand too hard. It isn't often that they come that way, for most molders don't like to work well enough to ram hard enough to get the iron like that."

"I never thought of that, but I guess you are right. Of course if the sand is rammed too hard it holds the iron tight together, and I have noticed that the real soft iron is full of little holes like. I'll go down and see Dan (Dan was the boss molder) and have him look out for the man who is doing this," and Charley started for the foundry.

"Say, Dan, I don't want you to think I am a kicker who kicks just because he likes to, but there is something that you

ought to know. The man that makes the piston rings rams his sand so hard that I can hardly cut the iron."

"Is that so?" said Dan, looking very much surprised.

Tool.	Make.	Pulley, Inches.	Belt, Inches.	R. P. M.	Method of Drive.	H.P., Computed.	H.P., Motor.
Double planer and matcher	Berry & Orton Co.	16	8	854	Individual	29.60	30
Swing saw, 30-inch	D., L. & W.	6	4	1,700	"	10.68	10
Rip saw, up to 24-inch	D., L. & W.	6	5	1,700	"	13.60	15
Double planer with matcher	S. A. Woods Machine Co., No. 17.	14	8	920	"	31.13	30
Six-inch outside molder	C. B. Rogers & Co., Norwich, Conn.	8½	4½	800	Group	8.88	10
Cross-cut saw, 40-inch	S. A. Woods Machine Co., No. 188.	16	7	575	"	17.71	15
Sill tenoner	C. B. Rogers & Co., No. 0	12	8	500	"	13.24	10
Cross boring machine	S. A. Woods Machine Co., No. 230.	8	3	785	"	5.18	3
Boring machine, 4 spindles	S. A. Woods Machine Co., No. 325.	14	8	343	"	9.60	7½
Ver. car boring machine, 3 spindles	C. B. Rogers & Co.	10	5	350	"	4.75	5
Rip saw	D., L. & W.	6½	5	1,600	Individual	14.40	20
Automatic cross-cut saw, 36-in. h.	J. A. Fay & Egan Co., No. 3.	14	8	600	"	15.00	15
Rip saw, 24 inch	S. A. Woods Machine Co., No. 175.	12	5½	458	Group	7.48	15
Sticker, 5-head	Houston	12	8	750	"	19.42	20
Upright shaping machine	C. B. Rogers & Co., No. 0	8½	4½	720	"	8.61	7½
Matcher	J. A. Fay & Egan Co.	12	7½	900	Individual	21.75	20
Gaining machine	S. A. Woods	14	8	325	Group	10.00	10
Gaining machine	D., L. & W. (pneumatic)	14	6	730	"	13.46	10
Hollow chisel, hollow mortiser	S. A. Woods Machine Co., No. 7.	14	6	750	"	8.40	15
Three-spindle boring machine	Berry & Orton Co.	12	3½	400	"	4.53	5
Wood turning lathe		9½	2½	250	"	1.63	2
Wood turning lathe		9½	2	360	"	1.88	2
Saw grinding and sharpening mch.	S. A. Woods, No. 231	5	2	540	"	1.42	2
Automatic knife grinder	S. A. Woods, No. 221	10	2½	360	"	2.47	2
Band saw filer, scrapped	Chas. E. Wright	10	1½	45	"	.22	1
Band saw, 36-inch	C. B. Rogers, No. 3	12	4	500	"	6.60	7½
Swing saw, 22-inch	S. A. Woods, No. 232	10	5	550	"	8.72	7½
Hand planer	C. B. Rogers	4	4	3,500	"	15.39	10
Door and sash tenoning machine	J. A. Fay, No. 3½	10	4	880	"	9.70	10
Extra heavy 6 roll sizer, 4 sides	J. A. Fay, No. 111.	16	12	1,000	Individual	52.90	50
Flooring machine, fast speed	J. A. Fay, No. 17.	16	9	900	"	37.14	30
Double cutting-off machine	Greenlee, 40-inch, No. 5.	16	10	450	Group	19.84	25
Ver. car boring machine, 4 spindles	Greenlee, Cir. 342.	16	8	375	"	11.12	10
Same with Universal attachment	Greenlee, Cir. 330.	16	8	375	"	13.22	7½
Heavy self-feed saw	J. A. Fay, No. 3.	12	8	900	Individual	22.34	20
Combination ver. borer and gainer	Greenlee, Cir. 503, No. 3	18	10	540	"	26.78	15
Small ver. hollow chisel mortiser	Greenlee, No. 11.	10	5	900	Group	12.40	7½
Hollow chisel mortiser	Greenlee, No. 8.	14	8	700	"	22.02	20
Vertical car tenoning machine	Greenlee, Cir. 525, No. 4.	8	8	1,800	"	31.21	20
Double tenoning machine	Greenlee, No. 540.	18	10	900	Individual	44.64	40
Car brace cutting-off machine	Greenlee	10	8	900	Group	14.57	7½
Cross-cut saw	D., L. & W. R. R.	12	5	665		10.90	10
Wood turning lathe		9½	2½	150	Group	1.59	3
Cut-off saw, 22-inch	J. A Fay, No 2	10	6	700	"	9.64	7½
Groove saw, 12-inch	To build				"	10.00	10
Box board matcher	To build				"	5.00	5
Grindstone		24	5½	50	"	1.81	2
Heavy combined buzz planer	S. A. Woods, No. 97	12	6	1,000	Individual	19.84	20
Hollow chisel sharpener	Atlantic	3	2	3,000	Group	4.95	1
Band resawing machine	American Wood Working Mch. Co	20	6	480	"	16.92	7
Sharpener for circular saw	Atlantic	10	2	480	"	2.29	1
Band saw filing and setting mch.	Atlantic	10	1½	50	"	.20	1
Lathe		3½	2	2,000	"	3.42	2
Rip saw	S. A. Woods	12	6	458	"	9.03	5
Jig saw		8	3	675	"	4.45	3
Single surfacer	S. A. Woods, No. 88	5	4	3,000	"	16.55	15
Band saw	C. B. Rogers	12	3½	450	"	5.20	5
Emery grinder and dust guard machine		7	2½	642	"	3.40	1
Mortiser	R. Ball & Co.	10	3	300	"	2.50	2
Shaper	H. D. Stovers.	10	4	750	"	8.26	5
Knife grinder		5	3½	900	"	4.46	5

Aggregate computed H. P., 764.11.
Corresponding aggregate in H. P. of motors installed, 670.

TABLE 3.—MOTOR DRIVES IN PLANING MILL.

Building.	Dimensions, Feet.	Area.	No. of Arc Lamps.	Approx. spacing of Arc Lamps, Feet.	NO. OF INCAND. LAMPS.		Total Kw.	Total Watts per Sq. Ft.
					4 C.P.	16 C.P.		
Repair Shop No. 1	150 x 400	60,000	60	33	..	..	32.4	.54
Repair Shop No. 2	150 x 400	60,000	60	33	..	..	32.4	.54
Paint Shop	60 x 400	24,000	26	32	..	45	16.74	.7
Annex	20 x 250	5,600	..	..	..	75	4.5	.8
Planing Mill	90 x 400	36,000	23	40	30	..	13.	.36
Machine Shop	80 x 180	14,400	16	26	15	..	8.93	.62
Blacksmith Shop	80 x 300	24,000	12	40	..	..	6.48	.27
Power House	50 x 180	9,000	4	35	..	10	2.76	.31
Office and Storehouse	44 x 105	4,620	..	..	..	50	3.00	.65

In cases where arc lamps are staggered, the diagonal distance between lamps is given.
201 arcs were originally installed for interior lighting, all fitted with concentric diffusers, together with 30 arcs for outdoor lighting. Of the total number of arcs now in use, the majority are of the multiple type. The series arcs are supplied from three 50-60-7.5 constant current transformers, and are used for all-night lighting of the grounds and buildings.

TABLE 4.—LIGHTING SCHEME OF D., L. & W. R. R. CO. SHOPS.

"Yes, it is," replied Charley. "It takes me more than twice as long to get out a set of rings as it ought to, and as you are working for the company the same as I am I knew you would be glad to know about it."

"I'm awful glad you told me," said Dan. "I don't believe I should have ever been next to that without your help." He wasn't quite sure that Charley was serious, for he knew that there were many shop sells, but this did not develop into one of them, for Charley went out with a look on his face that showed he had done a kindness to molders in general, and to Dan in particular. Of course he had always known that machinists are smarter than molders are. He had learned that soon after he entered the shop where he served his time.

Had he looked around carefully before leaving, he might have thought that the fellow who was at work near where the talk had taken place was having some kind of a fit. He came partly out of it soon after Charley was out of hearing, and as soon as he got his breath he shouted. "See here you, Bill! You villain, you! You are the fellow that is to blame for all this hard iron. It's no use for Dan to say that he hasn't the right kinds of irons or to tell us about sulphur and silicon, and one thing and another. Your being so 'fraid that your mold will swell is what is doing it all. You will have to quit ramming so hard. The machine shop is onto you. The first thing you know they will have all of the secrets of the foundry."

Even the guying that Charley got from the fellows in the foundry did not arouse an ambition to know anything beyond the work he was doing. If he is given a strange job to do he requires an amount of breaking in at first, but to offset that trouble he is content to work on the most monotonous jobs year after year. I do not think he ever owned a book on mechanical subjects or spent a dollar for trade papers, but he has had steady work at the going rate and owns his home and enjoys good health.

I do not wish to hold him up as a sample for the bright ambitious young man who is starting in life in a machine shop, but there is a point that I would call attention to. He *is* a good lathe hand, and after he gets it into his head just what is required on a new job he is all right. He *is* a success in the place which he occupies. He *is* a good citizen and has a nice family and home, and viewing things from the standpoint of his disposition and his limitations I would be very slow in saying that he had not been a success, *for himself.*

His lack of information is not in the same class with that of the man who was trying to sell a machine shop. I do not know what relation the man held to the machine shop before he tried to sell it, but if he had been running it I think he had good reasons for trying to get it off his hands.

The equipment of the shop as set forth in the circulars that were mailed to those whom he thought would be interested was not very elaborate, but according to them here was a chance to get an 8-foot "plane," a lot of "die sticks," and of more importance yet, a "brake test." I can imagine seeing an eager mechanical world reaching out and fighting with one an-

other to get possession of that "brake test." This man might have had a lot of general information under his hair, but to make things pay he needed some local knowledge of that machine shop and of machine shop practices, and before any man should reach out beyond himself he should get the local information.

That is the kind of information that keeps the pot boiling. W. OSBORNE.

Two Home-Made Traveling Cranes.

BY JOHN J. SMITH.

Not very long ago some correspondent of this journal made the statement that sometimes people desiring a crane built one for themselves, but that it was an experience not generally repeated. If that remark is true, our experience is an unusual one, and certain it is that our two cranes have been successful for the purposes for which they were designed, and may therefore be worthy of illustration and description here.

AN ERECTING CRANE.

The first was desired for the erection of a large cross-compound Corliss blowing engine, with steam cylinders 26x48 inches and 42 inches, and two blowing cylinders 62x42 inches. The engine was a horizontal, but still the problem of getting the different pieces from the railroad track, which ran across just outside the end of the engine-house, into the house and into position, was one of no little moment, and it was considered that a hand-power traveling crane could be built, whose assistance in this operation would be so great as to largely pay for its cost, and that the "insurance" feature of having ready means of handling parts in case of repairs or breakdowns, would pay the rest. Such expectations cannot be exactly measured in dollars and cents, but the general consensus of opinion of those most intimately concerned, not only in doing the work but paying for it, was that the expenditure was justified.

When the crane design was undertaken, the builder of the engine was requested to state how much the largest piece would probably weigh, and he responded that the frames would probably weigh about 12 tons.

No convenient means of transmitting power, such as compressed air or electricity, was then at hand, and the crane was to be purely a hand-operated affair throughout. The hoisting arrangements proper were to consist of Yale & Towne triplex blocks, and as these are necessarily slow in the large sizes, and as there are so many more small parts to lift than large ones, it was considered advisable to have two trolleys, a main one carrying 12-ton blocks, and an auxiliary one carrying 4-ton blocks which could readily be converted to 2-ton ones of double the speed, and this was the plan that was followed in the design of the crane. This design is shown quite plainly in the accompanying drawings. On account of keeping the height of the building as a whole as low as possible, the very common practice among crane-builders of arranging the trolley to run on top of the main girder was discarded, as this adds the height of the trolley to that of the main girder, and the sum of these plus the necessary clearances must be the clear height between the highest point over which the trolley must pass and the bottom of the roof chords. By putting th trolley inside the main truss of the crane proper, the entire height of the trolley is saved, but, of course, at the expense of providing a support for the rails other than the top of the main girder.

THE BRIDGE.

These were the controlling considerations in the design, and a brief inspection of the drawings will show how the details were worked out. The girder consists of two plain trusses which, instead of a pair of king posts, have four so arranged as to support the top chord at as many points and as equally as possible, so as not only to give it the necessary strength as a whole, but to prevent excessive deflection by local loading, with the trolley in any position whatever. It is perhaps a shameful thing to confess, but the exact size of the timbers in this main girder was not accurately figured. A size much smaller was assumed, and a brief calculation made which showed that they were much too small; 10x18-inch timbers were then adopted as being enough bigger to stand not only the compression stresses but the local bending stresses introduced by the trolley, which in practice they have shown themselves amply able to do. The end castings are plainly shown in Fig. 1, and consist of a frame carrying the timbers on their tops with pedestal jaws at the bottom which take boxes and brasses similar to those of ordinary railway cars. At the right-hand end, these end frames are prolonged down to form supports for the worm-shaft bearings. This worm shaft is driven by a sprocket wheel for a hand-chain in the center, and carries under one of the axles of the crane a Hindley worm meshing with a worm gear keyed on that axle, the ratio of these two being 35 to 1.

THE BRIDGE TRAVERSING MECHANISM.

It will be noted that the flanges of the wheels are turned outward for the reason pointed out many years ago by Professor Sweet, that if the flanges are on the outside of the rails and one end of the crane gets a little ahead of the other, the biting of the flanges will tend to stop the end which is ahead and make the crane square itself with the track, whereas if the flanges are on the inside, the biting of the wheels will tend to increase the slewing which causes that action. In order to obviate as far as possible any trouble from torsional deflection of the axles in the length of the crane, a comparatively short section at each end was made solid, and the space between, about 18 feet, was filled with a shaft made of extra-heavy pipe carrying flanges to match those shrunk on the solid portions of the axle. The method of attaching these flanges to the pipe consisted in making rough plugs of about the bore of the pipe, heating the ends of the pipe red-hot and shrinking them down on these plugs, turning up the ends and shrinking the flanged couplings to these ends. The plug in the center prevented the collapsing of the pipe, and has made a connection which has given no trouble whatever, though submitted to very heavy strains. The rigidity of the pipe is so great that no objectionable effects from driving at one end only, have been seen, and moreover the lightness and stiffness of the pipe enabled us to dispense with bearings on it except one in the center.

SUPPORTING THE TROLLEY RAILS.

The method of supporting the rails for the trolleys is best shown by the end view of the crane. Below and to the left will be seen a drawing of one of the individual brackets which serve to support the rail. The original intention was to use deck beams instead of rails, on account of their much greater strength and stiffness, as this would have enabled us to get along with very many less hangers. Deck beams, however, are a structural shape which have become in recent years very difficult to obtain, especially in small orders, and therefore 75-pound rails were used. One not being long enough, the joint was brought on one of the hangers.

It will be observed that the hanger is bolted to the side of the top chord, and that it has at its top a notch 1½x1 inch deep. This notch takes the ends of 4x6-inch angles of the proper length, which span the crane trusses from side to side, as clearly shown in the plan. Through these pass 1⅛-inch bolts, which run down just inside the top chords and through the bottom of the rail brackets, just as close alongside the rails as the end clearance for wheel hub would allow. It will be seen that this throws all the tension strain on the bolts, which sustain practically a direct pull, while the back rib of the brackets is thrown into compression, and except for the very small overhang of the rail beyond the bolts, no part of the rail bracket is in tension. This was a detail which occasioned considerable thought, and as finally designed gave entire satisfaction. The side bearings for the wheel shafts are clearly shown and involve nothing of particular interest. They were babbitted in place so as to bring them in line.

Before leaving the subject of the main crane truss, it may be well to point out that horizontal sway bracing of 4x6-inch scantling was put across from side to side between the angle irons. This tied the timbers together and prevented any dan-

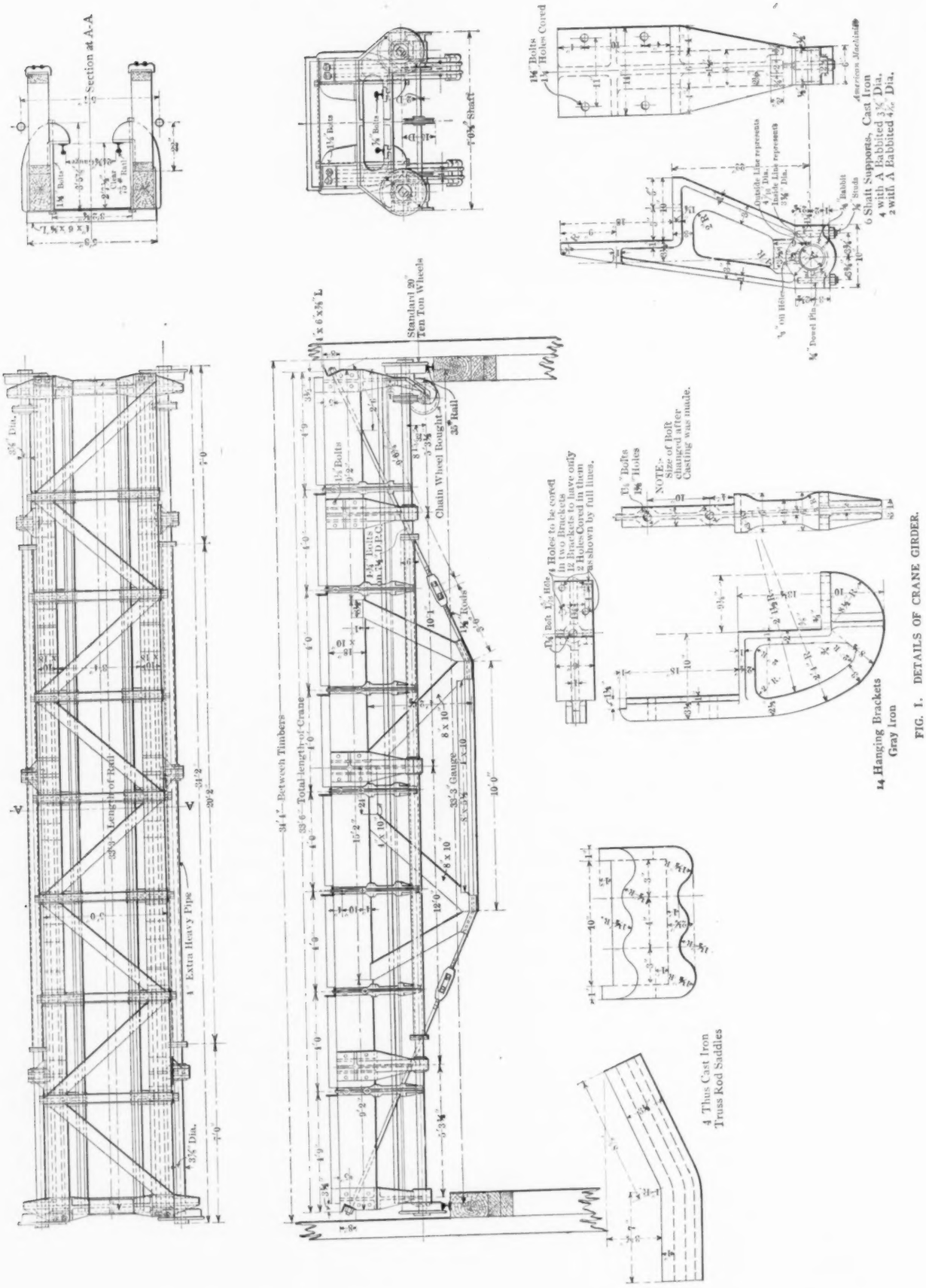


FIG. 1. DETAILS OF CRANE GIRDER.

ger of lateral yielding followed by collapsing, which took place with more than one crane in the earlier days of building these useful appliances. The end castings are shown quite plainly in the end view. They were made in two places for reasons of convenience and to facilitate the erection of the crane. The center was cut out for lightness, but it became obvious, after the work was done, that it would have been better if this metal had *not* been saved. No indications of weakness were ever noticed, but the homely old criterion of looks showed that this was not the proper place to have saved this quantity of metal. The method of supporting the wormshaft seems very awkward, but appears to be the best obtainable after much scheming. It was not expensive to construct, and gave no trouble in operation.

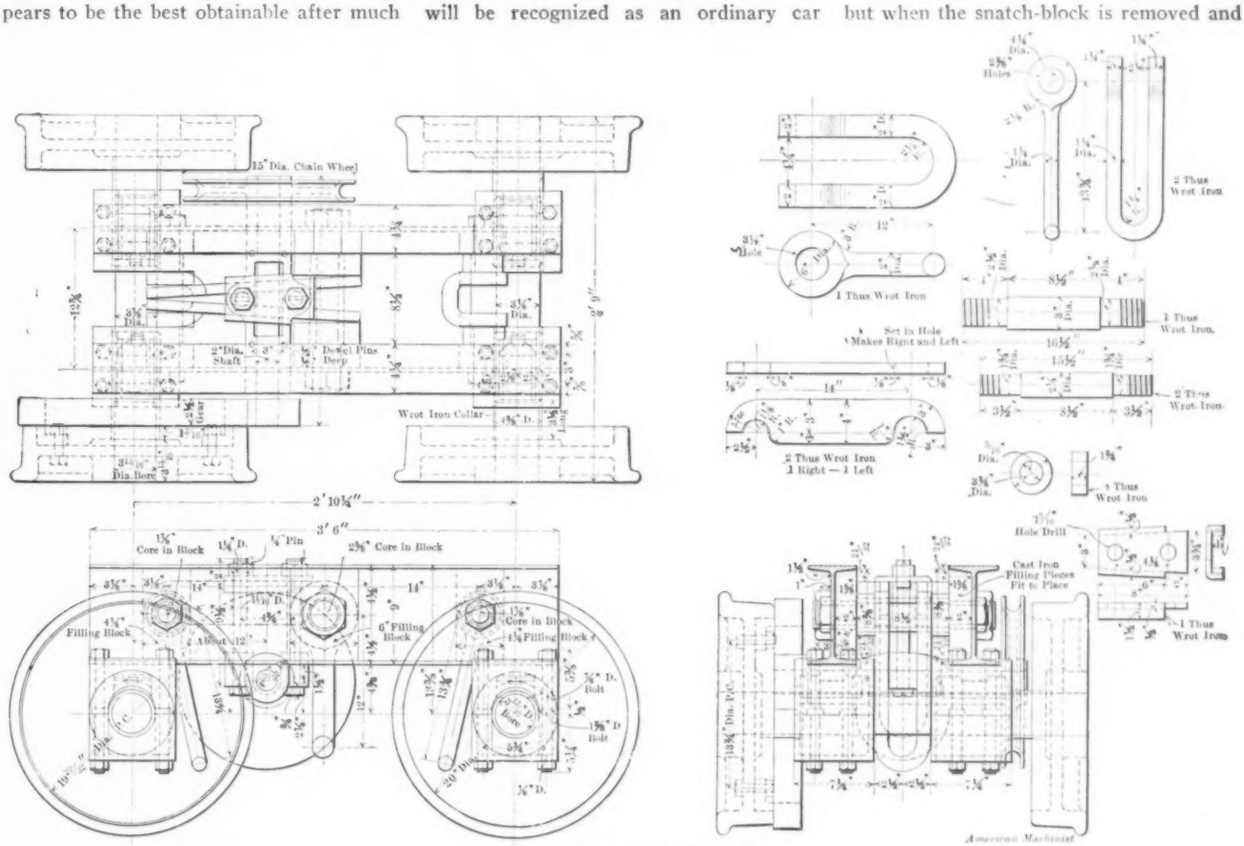


FIG. 2. TWELVE-TON TROLLEY.

THE TROLLEYS AND HOISTING BLOCKS.

Two trolleys were provided, as already mentioned; on both of these the propelling gear was the same, though one of them being for a 12-ton hoist, was much heavier than the other, which was for 4 tons. The block used with the 12-ton hoist was the 3-hook block of the Yale & Towne Company. This consists of the mechanism of two 2-ton blocks, complete, with sufficient chain to pass over a double sheave block at the top, and a three-sheave block at the bottom. This puts two tons on each of the block mechanisms, and eight tons on the central hook at the top, carrying the two-sheave block; the hangers, as shown on the trolley drawing, Fig. 2, are designed with this purpose in view. The traversing gear for the trolleys was made as simple as possible, and consisted of a hand-chain sheave obtained from the Yale & Towne Company to suit their open-link hand chain on one end of the cross-shaft running under the I-beams of the trolley, this shaft carrying at its other end a pinion of 1¼-inch pitch. This pinion meshes with a spur gear, of a pitch diameter slightly smaller than that of the treads of the trolley wheels. There being little room to key this to the axle, and direct drive being desired, this gear was cast with short feet to correspond with the ribs on the trolley wheel, which will be recognized as an ordinary car wheel of narrow-gage type. These feet were turned up on the bottom and outside face, while the web and inside of tread of wheel was turned up to correspond. Only one wheel was driven, the axle being short and stiff, with no danger of derangement by torsion. This only gave one-half the weight on the trolley for tractive effect, but proved to be sufficient. The ratio of pinion and gear is about 4 to 1. The bearing of the cross-shaft for pinion and sprocket wheel is cast in one piece, with an open trough in the center into which oil can be put so that it will work out through the bearings at either end. This whole casting is secured to the I-beams by dowel pins and supported by saddles from above, as shown. The 4-ton trolley does not differ in construction from the 12-ton one, except in minor details, and in the fact that the 4-ton block used was a 2-hook block. This block consists simply of an ordinary 2-ton triplex block of the Yale & Towne Company's make, with extra-long chain and provided with a single sheave carrying a hook which runs on the chain. This is practically no more than a snatch-block, adapted to be used with the hoist chain. The sheave-pin of this block is easily removable, and it can be put on or taken off in a few moments at any time. When the end of the chain is hooked up and this sheave is in place in the bight of the chain, the lifting power is doubled and the speed is halved, so that it becomes a 4-ton block; but when the snatch-block is removed and the end of the hoisting chain unhooked from the trolley, it becomes a plain 2-ton block with double the speed. This proved to be an extremely valuable feature, the block being strong enough to be of great assistance for heavy work, and yet fast enough to pick up relatively light parts quickly and easily. It was used as a 2-ton block probably three-fourths of the time. These blocks performed their service throughout in a manner that was practically faultless and beyond criticism.

THE OPERATION OF THE CRANE.

It has been mentioned that a railroad track ran across the line of the house, just at its rear. The rear end of the house was therefore left out entirely when it was built, and the craneway was tempo-

rarily extended out over the railroad track, so that the crane could go out over the track, pick up any piece from the cars, carry it into the house and set it down in place without more ado. The operation of a crane of this sort is necessarily slow; the total weight of the crane itself was, with the trolleys, 6 or 8 tons, and it took about seven or ten minutes to move it the length of the house and over the railroad tracks, a distance of about seventy feet. When unloaded it could be moved by one man, but when heavily loaded it required about three men on the hand-chain to move it at any reasonable rate of speed. Similarly with the hoisting; the speed of hoisting of a 12-ton chain block, with two men on each hoisting chain, is probably in the neighborhood of one foot a minute after it begins to take its load. The traversing of the 12-ton trolley was more rapid than either of the other motions, but when heavily loaded required at least two men on the hand-chain; when light, it could easily be moved with one hand. When the engine was actually completed, the shipping list showed that the weight of one of the air cylinders, with its heads and piston in, was about 20 tons, while the frames weighed about 15. The former was considerably more than the joint capacity of the blocks, but by removing the heads and valves the cylinder was lightened somewhat and brought down to about 18 tons, which weight it was estimated it would be safe for the joint capacity of the trolleys, as there would be no surging or jerking to throw extra strains on them, an expectation that was fulfilled in the amplest degree. While it would have been undesirable to do so, it seems unlikely that the trolleys would have carried one-half more than their nominal capacity, as the crane body certainly would, with entire satisfaction.

The method of chaining these heavy cylinders so as to give each trolley its proper proportion of the total load, may be of interest. The cylinders were of the Corliss type, with valves about 14 inches in diameter. A heavy chain was passed around the projecting ends of the valve chambers, as close to the cylinders as possible on one side, and the 12-ton trolley was hooked to this. Into the valve chambers, on the other side, were put heavy timbers, which projected three or four feet, and a lighter chain was fastened around these at about three times the distance from the center line of the cylinder that the large chain was, and to this chain the 4-ton hoisting chain was attached. This brought one-fourth of the weight on the 4-ton trolley and three-fourths on the 12-ton trolley, and in such a way that no slight difference in rate of hoisting could throw too great a strain on the lighter trolley and break the blocks. It also gave a beautiful means of getting the cylinder dead level laterally in lowering it on its bolts. This was the heaviest job that the crane was called upon to perform, but it did it with as much ease and as satisfactorily as any of the others.

The general verdict was given at the end of the erection of the engine that while the work would not have been impossible without the crane, it would have been of such great difficulty that the expenditure for the crane had been more than justified. The homely structure now stands in the engine-house with practically nothing to do, but it is a constant guarantee that in case of trouble it will be there to help and to expedite repairs of almost any description.

FIG. 3.

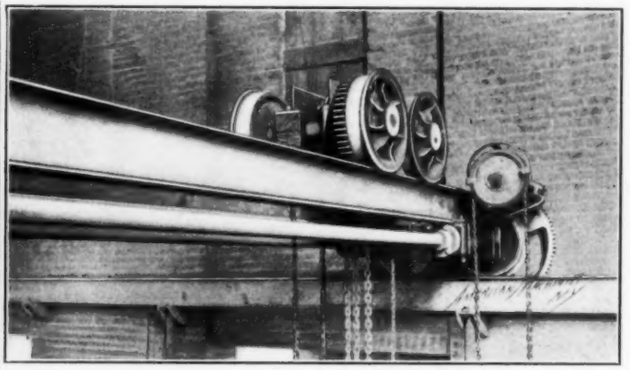


FIG. 4.

THE CAST-HOUSE CRANE.

A CAST-HOUSE CRANE.

Within a few months after the construction of this crane, and very largely in consequence of the very satisfactory service it had given, it was decided to install a smaller, but similar, apparatus over the molder's pit in the cast house, so that he could have its assistance for handling the heavier work which is incident to blast-furnace needs. It is a lamentable fact that the drawings for this last crane were never put into such shape as to be available for reproduction here. A few lines were made on a sheet of manila paper, and from these some sketches were gotten out from which the whole work was done. In the matter of a trolley it was decided that as the crane in the engine-house was practically "out of a job," there could be no harm in stealing from it the 4-ton trolley which would be of about the capacity wanted for the heaviest work when used as a 4-ton hoist, and be fast enough for all practical purposes when used as a 2-ton hoist. This was accordingly taken, and the crane designed to fit it to a considerable extent.

The details of this structure are quite plainly shown in Figs. 3 and 4. It will be noticed that this crane was not troubled for lack of room either laterally or in height, as one track runs close along the wall of the cast-house, and the other lacks considerable of reaching to its center. This outside track is supported on columns, one of which is shown in Fig. 3, which shows also the stay-rods and diagonal braces for securing this outer track, which consists of a single 10-inch I-beam, in its proper position.

The stay-rods, or distance bolts, are sections of 2-inch pipe with 1¼-inch threaded stubs welded into them. These pass through the webs of the I-beams and grip the latter with a nut on each side, so that the gage can be made exactly right. This prevents any lateral swaying of the track, but in order to prevent swaying endwise, diagonal braces were run from the ends of this outer I-beam back to anchors in the wall. The turn-buckle and part of the rod for the one at near end is shown at the top of Fig. 3.

The construction of the wheels, axles, cross-shafts and boxes, is precisely the same in general principle as that shown for the larger crane. The I-beams constituting the crane bridge were held together by two bolts at each end with nuts on each side of the webs of the beams, and this completed the bridge except for the brackets carrying the bridge traversing pinion, and a supplementary strap on top of each beam. The reason for this latter was that the teeth of the trolley-traversing gear projected beyond the tread of the wheel about ½ inch. This made no difference on the original crane, as the rail heads were narrower than the wheel treads with ample clearance, but this was not true of the flanges of the I-beams which constitute the trolley bridge, so in order to obtain clearance for these teeth a strap

of 3x½-inch iron was riveted along the center of the tops of the I-beams. This lifted the trolley wheels high enough for the ends of the gear teeth to clear the top of the beam.

The bridge-traversing gear consists of an arrangement precisely similar to that used on the trolleys in the large crane except that the ratio is considerably greater. The same size pinion is used, but a larger gear, giving a ratio of 7½ to 1, was fastened to the back of one of the crane bridge wheels, so that the gear ran behind the I-beam and between it and the wall. This gear was fastened to the wheel by flat feet somewhat as in the trolley-traversing gear, but with the disagreeable difference that the feet had to fit into pockets between the ribs on the back of the web of the wheel. In order to avoid an endless job of chipping and filing to fit these, in these rough spaces, the ends of the feet were made to the correct shape as nearly as possible; the gear was put in its proper relation to the wheel and hard babbitt cast between the feet and the wheel, this babbitt being only about ⅛ inch thick, just enough to make a good bearing between them. Bolts through some of the feet held them to place against the wheel, while steady-pins through the other feet located the two pieces in their proper relation and acted as drivers.

The pinion shaft carrying the chain sprocket wheel at its outer and is clearly shown in Fig. 4. The bearing for this is a tube of cast iron carrying small feet which bolt to the wrought-iron brackets on the side of the I-beam. The tube is bored out to fit the shaft at the ends and chambered in the center. The oil-hole is in the side of this chamber, not in the top. Being in the side prevents the chamber being filled so full of oil that most of it will waste out around the ends right away, and it also almost entirely prevents the entrance of dust which has nothing but a vertical surface to lodge upon at that point.

The crane is so simple as to hardly deserve the name, but, like the other one, has given entire satisfaction in service, and though in use only a short time has undoubtedly paid for itself. On the other hand, a crane of more expensive type would have very few advantages for such a relatively small quantity of heavy work, and would actually require much longer to pay for its much higher initial cost, so that for the conditions for which it was designed, it is probable that the very simple hand crane has fulfilled its purpose better than a power-traveling crane would have done—that is, has paid a higher rate of interest on the money invested, which, after all, is a pretty good criterion of the value of equipment in general.

The first steps have been taken by the managers of the Australian State Railways to "electrify" a large section of the system. For this purpose the water power in the Alpine regions has been secured.

Skin-Drying Foundry Molds With City Gas.

EDITORIAL CORRESPONDENCE.

For some time the Colorado Iron Works Company, of Denver, Colo., has discarded the oven for drying foundry molds, and substituted city gas. The method is especially applicable to molds in the floor for heavy castings, of which many are made; but it has proven so expeditious and economical that it has also been adopted for smaller molds made in flasks, which might be dried in the oven. Large and deep molds made in the ground are not well adapted to photographing, and the illustrations which accompany this article have consequently been made from a mold made in an iron flask for a U-pipe for a hot-blast smelting furnace. They show the method very clearly.

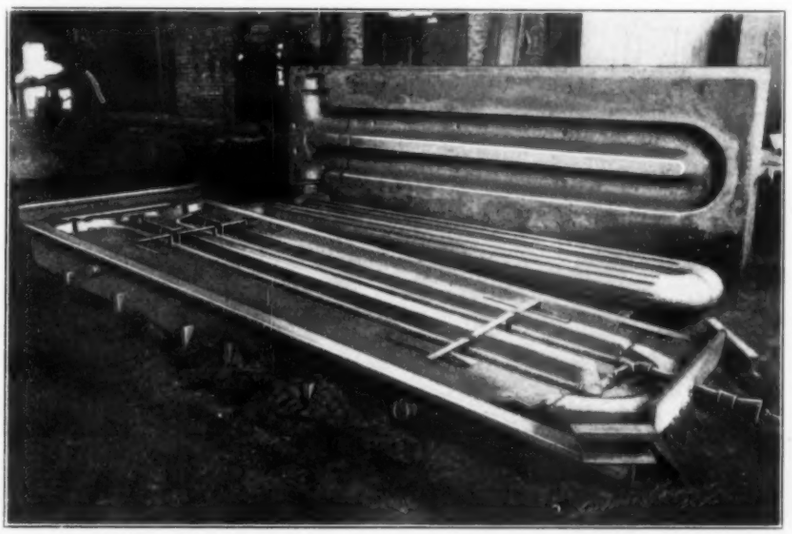


FIG. 1. THE MOLD OPEN, SHOWING ARRANGEMENT OF PIPES.

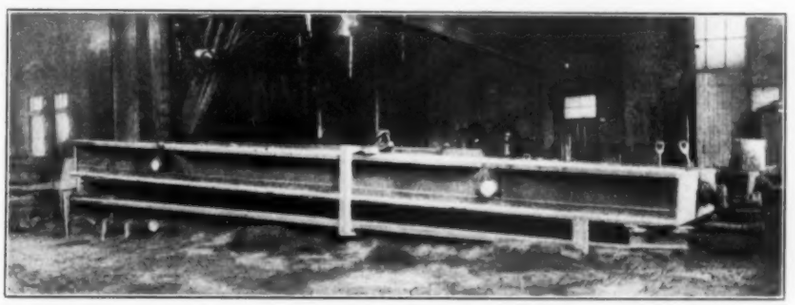


FIG. 2. THE MOLD AS ARRANGED FOR DRYING.

Fig. 1 shows the cope, drag and core forming a complete mold for one of these pipes. Some bent pieces of flat iron are laid across the mold to support a system of ¾-inch gas pipes which are built up to conform in a general way with the interior contour of the mold. The pipes are connected up with a larger section which extends without the mold and has fitted to it a conical end to serve the purpose of a mixer and draw air into the pipes with the gas, in order to give a Bunsen or blue flame. A small pipe is connected with the gas main by a piece of hose, its end being fitted with a regulating cock and extending within the cone-shaped end of the mold pipes in order to give an injector action and draw in the supply of air. The adjustment here must be such as to give the proper proportion to the mixture and maintain a slight pressure throughout the system of pipes, as otherwise back-firing will occur, the gas burning within the cone. The pipes within the mold are drilled with a large number of small holes a sixteenth of an inch or less in diameter, from which small jets of blue flame issue.

Fig. 2 shows the mold as partly closed for drying, the cope being held up from the drag about four inches by blocking. Jets are seen burning along the whole length of the drilled pipes within the mold. The space between the two halves of the flask, as seen blocked apart in Fig. 2, is closed with boards clamped in position to retain the heat. After the mold is dried, the cope is lifted off by the traveling crane, the pipes and blocking are removed, the core set and the cope lowered on.

Some experimenting was found necessary at the start to get the proportions right, but no difficulty is now experienced, and the method is largely used with great satisfaction and economy over the oven.

F. A. H.

Felling a Large Chimney.

BY DR. ALFRED GRADENWITZ.

At the works of A. Koppel, Ltd., of Bochum, Germany, a large chimney had recently to be felled, as a junction track was to be reconstructed. The preparatory work consisted in withdrawing part of the masonry from the base and replacing it by wood struts on the eastern side between the railway dam and the junction track, where the chimney was to drop. The masonry in the base was withdrawn stepwise and replaced by wood struts, while large amounts of readily combustible matter, especially straw, were heaped up within the base.

Fig. 2 shows how, the combustible matter being lighted, the chimney is turning slowly eastward, breaking into three parts on its way down, as shown in Fig. 3. In Fig. 4 are shown the débris of the turned-over chimney.

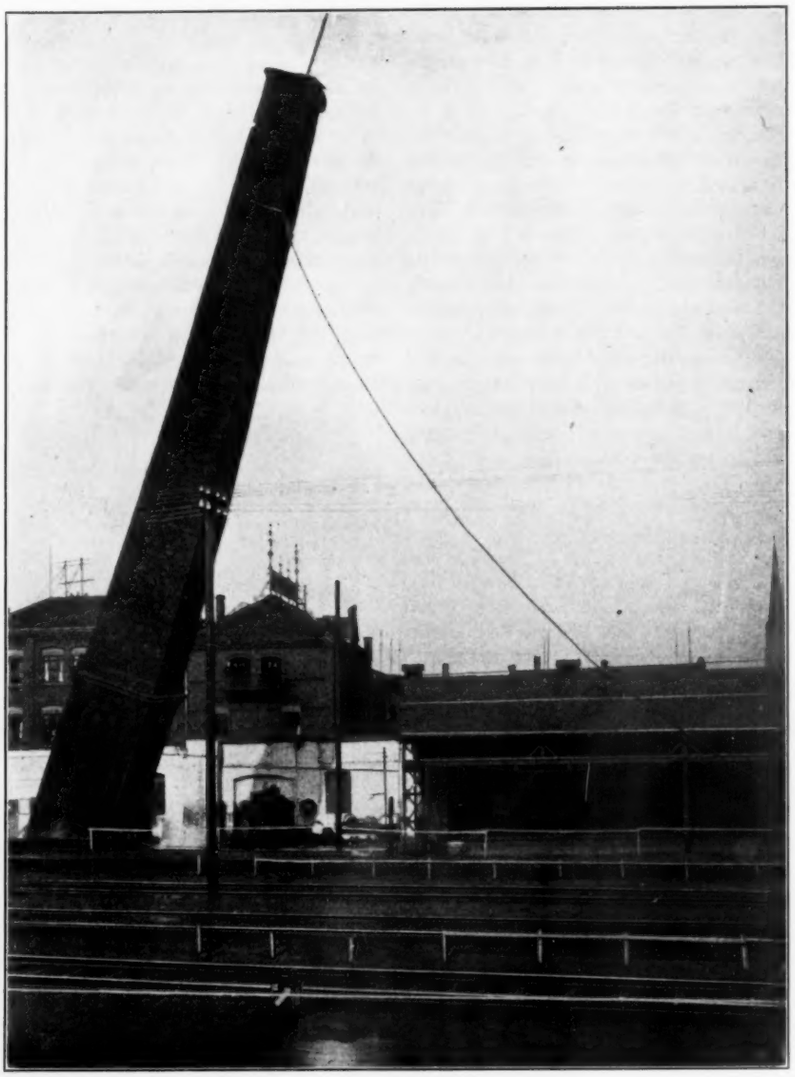


FIG. 2. THE CHIMNEY FALLING.

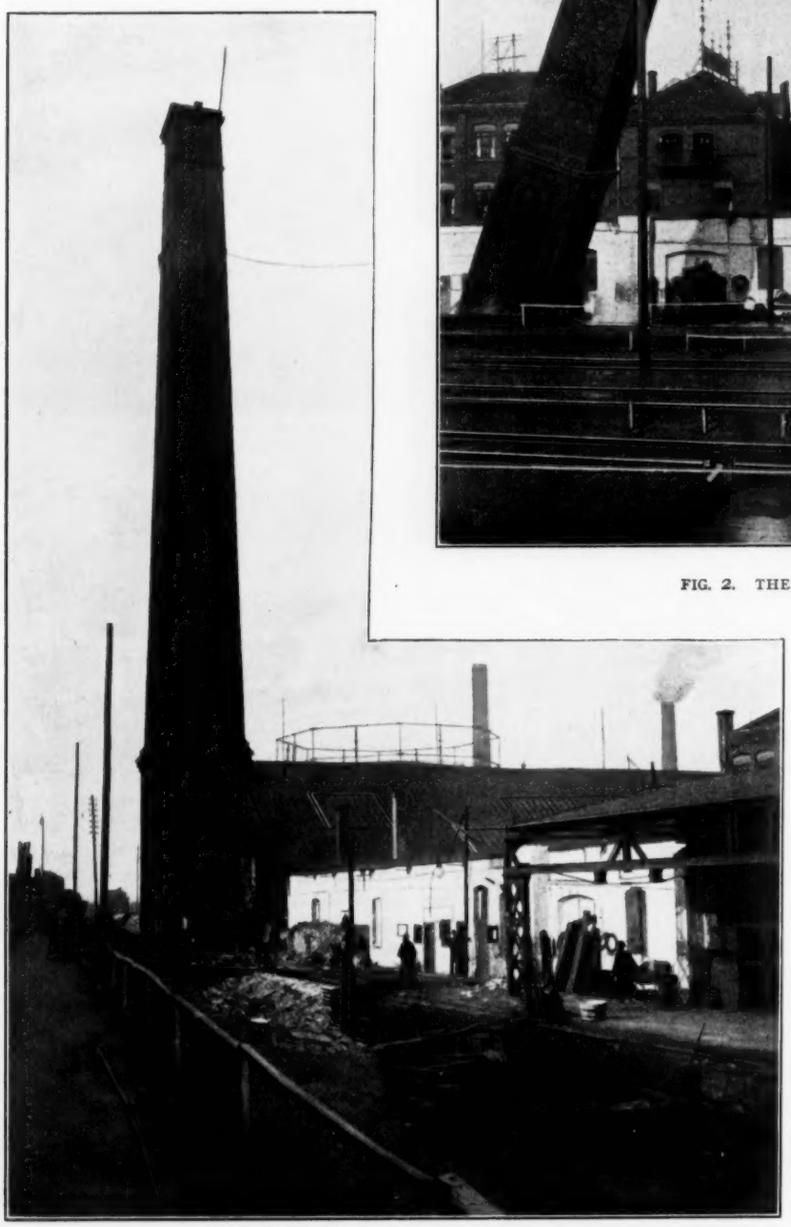


FIG. 1. THE CHIMNEY PREPARED FOR FELLING.

The work was performed without any disturbance or irregularity, and lasted somewhat less than two seconds from the instant the chimney began turning over. The chimney dropped accurately in the direction calculated.

The Largest Passenger Steamship.

The new twin-screw ocean liner "Amerika," of the Hamburg-American line, which reached New York recently on its first trip, is nearly 700 feet in length, has a breadth of 74 feet 6 inches and a depth of 53 feet. Her displacement is about 42,000 tons, her gross tonnage about 23,000, and she can carry 16,000 tons of cargo. She has accommodations for 3,400 passengers in addition to a crew of 600. Among the novel features are an electric passenger elevator, stateroom telephone service, hydropathic and electric baths, a gymnasium and a submarine signal system, with which the location of light-ships and lighthouses

can be found by bell signals, etc. The ship is driven by quadruple-expansion engines of over 15,000 horse-power, and will make the run from New York to England in about seven days, and to Hamburg in about eight and a half days.

About 36,000 passengers cross the Brooklyn Bridge by the bridge cars in a single hour every night when the traffic is most dense. The cars are designed to accommodate forty persons, but actually carry three times this number.

FG. 3. THE CHIMNEY FALLING.

FIG. 4. THE CHIMNEY FELLED.

Bench-Lathe Attachments.

BY F. J. LE CARD.

In Fig. 1 is shown one way of using a cutting-off tool in a bench-lathe slide-rest. The blade *A* is one of several sizes or thicknesses as fitted to the well known Johnson holder, *B*, and the latter is reduced in height, the tool-post being opened at the same time to obtain the result shown. That is, the ring and rocker seen in Fig. 2 are removed, when the cutting-off tool is always brought and held dead to the center of the work by using the ring or seat *C*. The rings, of course, easily pass over the tool-post without removing the handle.

Fig. 3 illustrates a tool of similar character that I saw in use in the gage room at the Mergenthaler linotype shop. They had two there, a small one for the bench lathe and a larger one for the engine lathe. In the use of these tools the regular tool-posts were removed completely and the fixture as shown substituted.

ATTACHMENT FOR THE SLIDE REST.

The succeeding sketches for the most part illustrate an attachment for a bench-lathe slide-rest (although easily arranged for the engine lathe), and it can be readily applied to any of several well known bench lathes by simply removing the tool-post. In a greater part of the milling and grinding operations on such work as cutters, taps, reamers, small punches, dies, etc., the requirements as to position, etc., are quite exacting; so that an attachment to the slide-rest, supplementing its all-around horizontal action with a vertical movement of even 3/8 inch above and below the lathe center, will "meet a long-felt want" in the small-tool department.

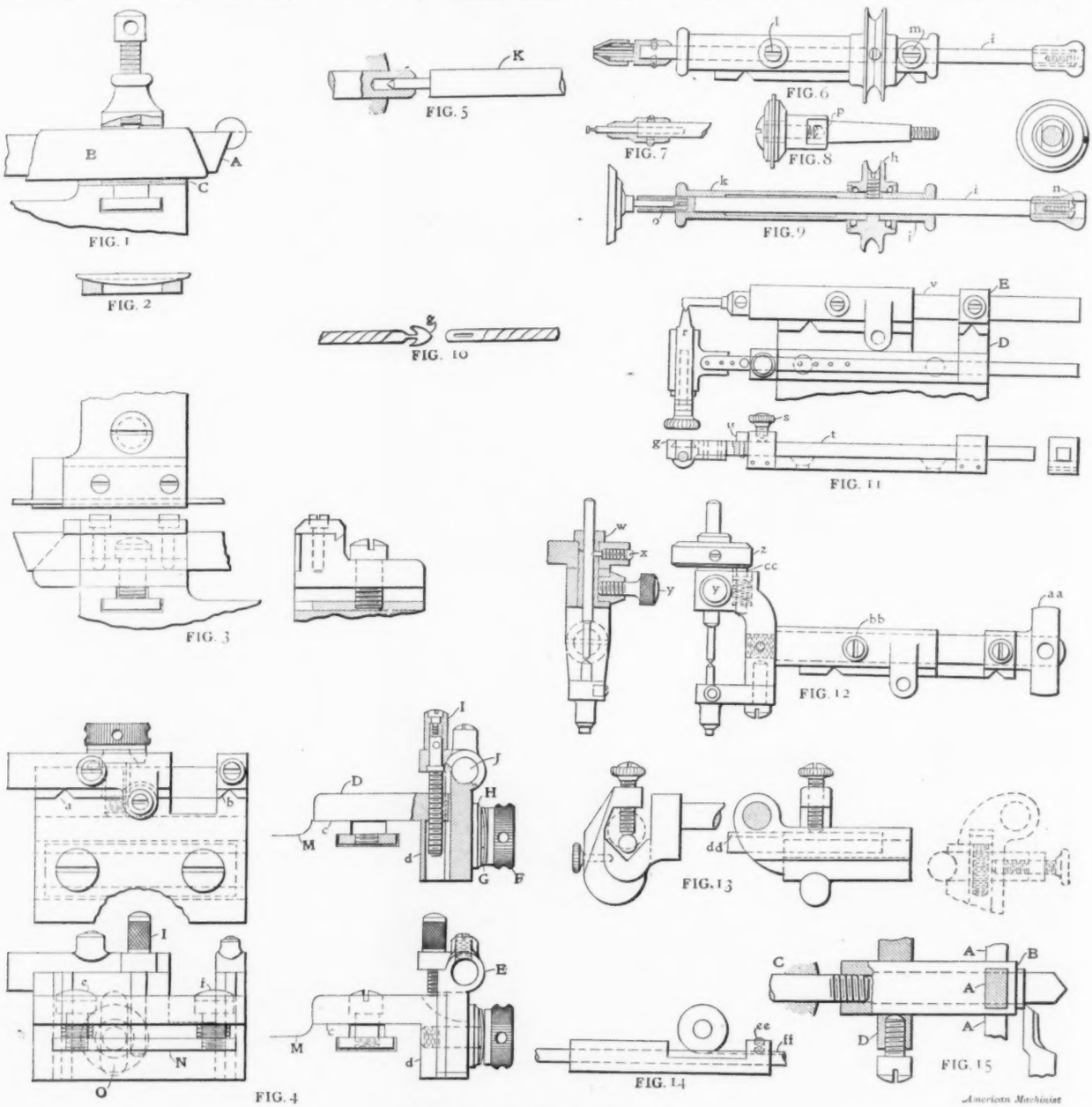
If any bench or engine lathe maker sees fit to utilize (as he is welcome to do) the devices shown here, or improved ones for the same purpose, he will certainly add to the comfort and usefulness of the tool-maker.

Fig. 4 gives the holder for the devices shown in sketches following. The pieces *D* and *E* should be made of machine or tool steel. *E* slides vertically at *a* and *b*. The binding piece *F* may be turned by hand for many cases or fastened securely with a pin. The saucer spring *G* and washer *H* are intended to furnish sufficient tension to hold *E* in the grooves *a b* while moving, as for sinking a cutter in the work, etc.

The handle *I* with features common to slide screws generally needs no description; only it should be indexed, with the *O* mark to indicate the center *J* at the height of the lathe centers.

Fig. 5 gives a practical plan for alining the attachment horizontally, the end of spindle *K* entering the hole in the rod *L* held in a lathe chuck. The same spindle having a pointed tip can be used to find or locate cutters on face-plate work.

The surfaces *c* and *d* on *D*, Fig. 4, in contact with the slide-rest *M* position the former normally with the latter; and by elongating the slots for screws *e* and *f* the fixture conforms to different rests. The binding bar *N* in one piece for both screws, is provided with springs that relieve the same when the screws are loosened, and hold it in position for ready entrance again. The slot shown by dotted lines at *O* gives an idea of the vertical adjustment in this particular case.



BENCH-LATHE ATTACHMENTS.

A GRINDING AND DRILLING SPINDLE.

Figs. 6 to 9 inclusive, show an attachment for this holder for either grinding, or small drilling at high speed. I found during a long experience in factories doing much small grinding that the men doing much of that work, if given their own way made a very light grinder with a small spindle, and one easily placed in the slide-rest.

Kerosene makes the best lubricant, and stays long. For a driving belt for a light wheel I have never seen anything better than one like that shown in Fig. 10. It is ⅛-inch twisted leather belting, very soft and tough. A barb *g* and a slit as seen make a fine connection.

Along this line, the best flat belt driver for a bench lathe is a very thin, soft leather belt laced with eelskin, which works entirely free from thump. And further, the only satisfactory thing I have ever seen for steady-resting smooth work that must not be scored, is vellum wound around the work, and coming between the work and the points of the steady-rest jaws; one end of the slip of vellum being clamped to one of the jaws to secure it. This will not heat at high speed, rough up, wear out, nor allow the work to loosen. It should be well oiled.

Returning to Fig. 9, the pulley *h* is shown here mounted free from the spindle *i* while revolving it by the end of the screw entering the groove in *i*. This principle has been used for years on watch tools. The experiment in this case is in using ball bearings.

The pulley runs on the ends of the hardened and ground sleeves *j* and *k*, which are held in place by screws *l* and *m*, which should have tips entering holes in the sleeves to prevent pressure on the spindle. The spindle *i* is entered from the front after removing the handle by taking out the screw *n*.

Chucks for drills and wheels may be

held in several ways. The end of the spindle may be tapered and drill holders, etc., wrung on; or they may be held like the split chuck in Fig. 6.

Fig. 7 shows the use of a dental bur or mill made in a large variety of shapes and sizes, of 0.092-inch wire.

Fig. 8 is the best wheel arbor that I have ever used. It is seen at *o*, Fig. 9, mounted in spindle *i*. A soft plug is soldered into a hole left for the purpose in the hardened spindle, bored out and reamed to standard size and tapped at the bottom. The taper shank on the arbor is fitted to the plug instead of the spindle itself on account of the screw which sticks through the plug. The arbor is tightened with a wrench on the flattened sides *p*. It never jumps out; and there is no hammering to break wheels in driving in and out of the spindle.

A SETTING GAGE FOR THREAD TOOLS.

Fig. 11 is a gage for setting and resetting at the same place an inside thread or chasing tool. The top of the gage *q* is at the height of the lathe center and being attached to the part *D* (Fig. 4) is not affected by the vertical movement of part *E* which carries the tool. Every toolmaker knows the sinking feeling that ensues when the point of a thread tool goes just as a fine thread in a small hole is half or nearly finished. By setting the thread tool at the start, as shown, it can be taken out, sharpened and reset as at first. After setting the tool the slide *r* is drawn back; the set-screw *s* loosened and the bar *t* removed. The pin *u* with the holes is for bringing the bar to the same place and covering different ranges. The large holder *v* admits of reaching into deep holes with a small inserted tool well supported.

FLUTING TAPS, ETC.

Fig. 12 gives a plan and front elevation of a milling device for fluting taps, taper or straight reamers, small counterbores—straight lip or angular—circular work, such as round or cherry cutters, concave, end cutters, etc. The full size of hole can be used or a reducer like *w* may be inserted. The work is held in place by set-screw *x*, and by thumb-screw *y*, as positioned by the index *z*.

The handle *a a* can be used for revolving the spindle as needed when released from set-screw *b b*. The pin *c c* is a finder for the division while *y* is tightened, an index line and figure being used to get the space needed.

A HOLDER FOR ROUND WORK.

Fig. 13 shows a V-holder for drilling or milling round work in the lathe; for instance, milling a keyway *d d*. For making a long slot such as that in the grinder spindle *i*, Fig. 9, hold the work as in Fig. 14. Remove the guide screw *e e* and hold the rod while the cut is started in the end, by a set-screw. Then insert the key pointed screw *e e* to guide the work *f f* as it is pushed through against the saw. The dotted sketch in Fig. 13 shows the V-holder dropped down for screw slotting.

A RELIEVING KINK.

Fig. 15 illustrates a successful scheme that I employed for backing off the end of a turret-lathe tool to make it form retaining when ground. *A A A* are the three jaws of a steady-rest, *B* the tool ready to be backed off. Instead of gearing up the lathe for thread cutting I held a ⅜x16 machine-screw body *O* in a chuck, and having a surplus end of the tool stock tapped out to fit, I turned the work on this screw for backing off. The lathe head was locked by tightening the bearings. *D* is a handle for turning the work. The same results in another case might be secured with the face-plate.

Very few people realize that the commerce of the great American lakes passes through an artificial waterway which is nearly five miles longer than the proposed artificial waterway across the Isthmus of Panama. There are nearly 45 miles of dredged channels from the head of the lakes to Lake Erie, meaning artificial waterways constructed by the Government for the passage of vessels. The money expended, however, has been well worth while, says the *Marine Review*. The annual sum saved in transportation charges on shipments from the head of the lakes alone is greater than the total amount expended by the Government on the great lakes since the navigation of them began.

The construction company is now ready to begin the preliminary work of electrifying the West Shore Railroad for 81 miles, between Rochester and Syracuse, which section is expected to be operated by electricity next summer, for both freight and passengers.

Letters to the Editor.

Molding With Sweeps.

The drum pulley shown in Fig. 1 is a special casting, and as only two castings were required from this particular size, it was decided to mold this piece with sweeps.

The patternmaking necessary to form this mold with sweeps consists of two sweeps each having a loose piece screwed on, so that a single sweep forms both outside and inside mold faces, and a half boss and four ribs conclude the patterns required.

The molding of this drum pulley is started by fixing a center in the floor and setting the spindle true. The first sweep is now set; this forms the bottom half of the outside shape of the pattern and is shown in Fig. 2. As this swept-up part is a dummy on which the bottom half of the mold is rammed no particular care is necessary except in the getting of a true shape; after obtaining this, parting sand is rubbed on with the hand and the sweep *A* worked round so that a true surface is obtained without any irregular or lumpy places. The sweep is now removed and the cheek placed on the joint, as shown in Fig. 3. In this figure the sweep *B*, which forms the top portion of the inside face of the mold, is shown set on to the top face of the dummy and just touching the sand, but not scraping it. Before ramming up the main part or cheek four wood parts *C* are jammed into the sides and a few long nails driven into the bars to help support the sand. After ramming up, the sweep *B* is worked round until a good surface is obtained. A parting is formed here in the same manner as with the bottom joint and the sweep is removed. A half boss is placed over the spindle and the four ribs set and the top part or cope placed over the mold which is now well

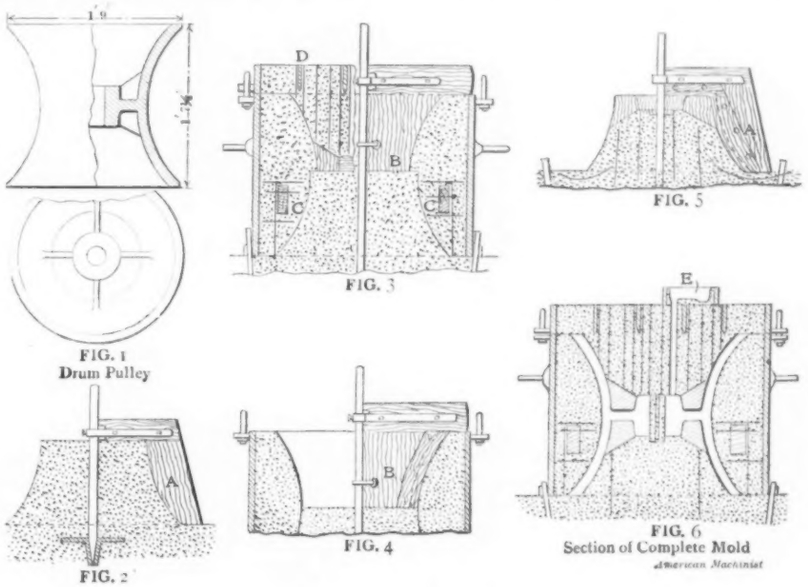


FIG. 1 Drum Pulley

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6 Section of Complete Mold

American Machinist

MOLDING WITH SWEEPS.

gaggered and rammed up. A section of the cope rammed up is shown at *D*, Fig. 3.

The cope is now lifted off and finished, and the sweep *B* having had the thickness piece screwed on is set, as in Fig. 4, in exactly the same position as before. This sweep is carefully worked round and smoothed until a true surface is obtained, after which it is removed and the cheek lifted off and finished. The dummy pattern is now dug out, care being taken to leave the bottom surface or joint intact, and the sweep first used having had the thickness pieces screwed on, is set; this forms the bottom inside face of the mold, the half boss and four ribs being again used. This part of the mold requires to be ironed so as to support the pockets of sand between the ribs, and the vent rod is pushed well down into the floor and the mold connected by curved vents from the outside.

Fig. 5 shows sweep *A* set and the boss and ribs in position. The bottom having been finished, the cheek is replaced, it having been carefully staked before it was lifted off the mold in the first instance. The center core is placed in position and centered from the outside of the mold and the cope placed in position. Fig. 6 is a section of the mold complete. *E* is the runner, and two risers (not shown) are at the top outside edge of the mold. The time taken to make a mold, as described, with sweeps, is considerably longer than would be the case working from a complete pattern; however, the making of two castings and the sweeps works out considerably cheaper than would be the case with two castings and a complete pattern.

GEO. BUCHANAN.

Wrexham, North Wales.

Repairing a Boiler With Red Lead.

A boiler whose venerable age entitled it to respect, gave us trouble through a leaky seam, while the state of the exchequer was such that we desired to avoid Mr. Boilermaker and his bills with which we had already had some experience.

Two 1-inch holes were drilled through the butt strap of the joint with a flat-ended drill, care being taken not to damage the shell itself. We threaded the holes to the bottom with a set of gas taps, spacing the holes twice the distance apart that they were from the extreme ends of the leak. A quantity of red lead putty smooth as oil, free from grit, and not too tacky was made ready. A bar of round stock was threaded to suit the holes, with a square end to take a double wrench. The apparatus we subsequently christened "the putty pump," and used it as follows: One of the holes was half filled with putty and the bar screwed down with the wrench; this repeated with each hole alternately until no more putty could be squeezed down. Around the seams and between the plates the putty could be seen squeezed through. Two plugs were then screwed hard down to their taper threads and cut off flush, thus making a neat job.

The boiler remaining out of commission for a day or so gave the putty a chance to harden, and the job lasted until I left, several months later. I don't recommend the method except to frontiersmen, but it got us out of a hole.

While on this subject I am reminded that red-lead joints bear a bad reputation in some quarters. There is no substance which you can buy at so many different prices as the chief part of the red-lead putty in use—*i. e.*, hydrated carbonate, commonly termed "white lead." Adulteration is very common and the result is that a reliable jointing material is generally mistrusted. The additional cost of the pure article would in this instance be amply paid. On several occasions when a joint under my charge made with red lead has given out, the failure could be traced to cheap white lead.

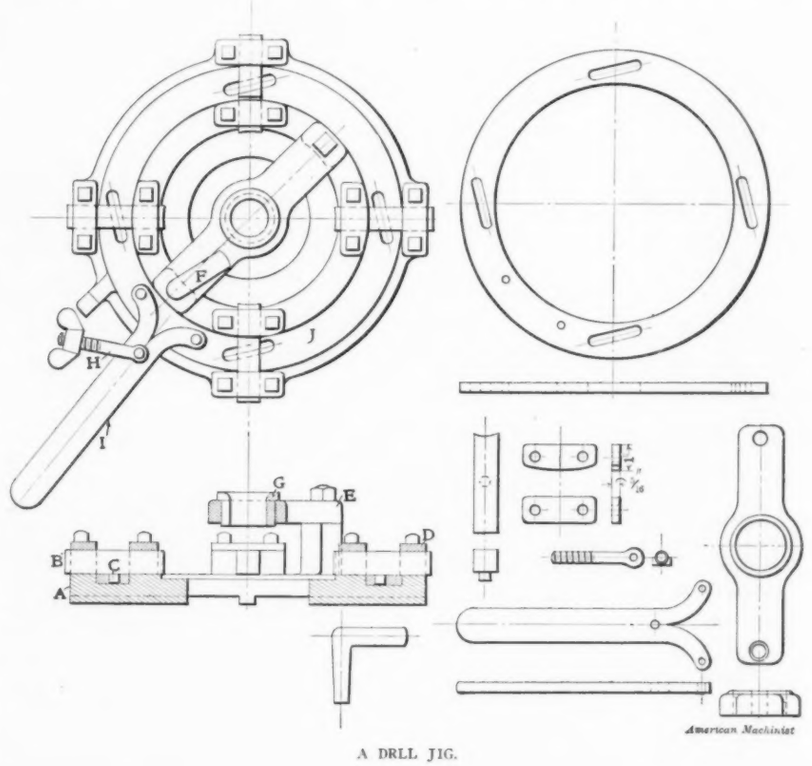
A. L. HAAS.

London, England.

A Drill Jig.

In agricultural implement work all parts are interchangeable, so that many and varied are the jigs, the drill press being used for boring, facing, drilling, tapping, etc., one operator attending from two to four machines. The illustration shows a style of jig used for boring wheel hubs, gears, sprockets, etc. The body *A* is of gray iron, turned out to receive the steel ring *J*. The jaws *B* have projecting pins which engage in the slotted holes of the ring. When the lever *I* is drawn around the jaws grip and center the work perfectly. One thing very noticeable in the majority of shop jigs is the sharp corners which could easily have been rounded in the pattern shop or tool-room.

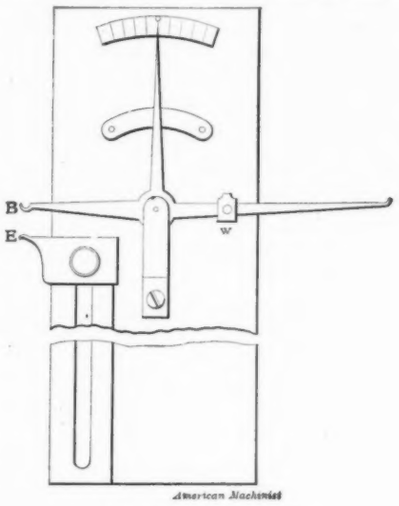
Canada. A SUBSCRIBER.



A DRLL JIG.

Spring-Testing Device.

With reference to the spring-testing device at page 59, Part II, I should think



SPRING-TESTING DEVICE.

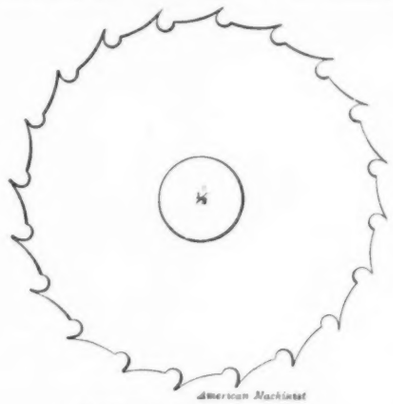
the arrangement in enclosed sketch would meet C. F. H.'s requirements better than the one he shows. In place of the right-hand "hooks" on pointer *B* and plate *E*, use a weighted lever, which can be divided to meet the requirements of the shop. A model spring is hooked on at *B* and *E*, and the weight shifted until the

pointer stands at zero, and then clamped by the screw. The model is then taken away, and need not be kept. All that is required is to make a note of the division for that class of spring. In C. F. H,'s case every time a spring stronger than the pattern (and there are bound to be some) is put on, the model is stretched, and of course made weaker, when it is no longer of any use as a pattern. A tool made after the sketch will always give the same tension to the springs, and those registering zero will be correct to pattern.

If C. F. H. keeps his model spring five or six years, which he ought to do, it being a pattern, he will find that it has oxidized or rotted to such an extent as to be absolutely useless. R. L.

Shape of Saw Tooth for German Silver.

I send you herewith a cutter which I used in milling german silver, also a piece that has been milled with it. Those who have worked german silver know how hard it is to work that alloy in almost any form. The cutter is an ordinary



SAW FOR GERMAN SILVER.

stock cutter of B. & S. make. In making the cutter every other tooth is ground down. The grooves are made with a narrow wheel with the periphery made round. The piece I send you has been cut after the cutter has cut over 2,000 pieces, while the ordinary cutter does not cut over a few hundred. L. I. ROSENTHAL.

[The sample referred to is 0.10 diameter by 2 inches long, a slot runs down one side of it cut by the saw which is .025 thick. The job is well done, and the saw seems sharp enough to cut 2,000 pieces more.—Ed.]

Another Repair Afloat.

A British steamer with limited passenger accommodation left Portland, Oregon, loaded for Japan, some years ago, and owing to bad handling or lack of water she grounded on the bar. The damage done consisted in the springing of a number of seams where the rivets were fractured or badly strained, so that the bilge on the starboard side of the ship under the engine and boiler rooms was leaking like a sieve. The trusty Worthington ballast donkey was requisitioned and kept the water down. No damage was inflicted to the plates of the hold and none of the plates, on examination, were found to be fractured.

The steamer when floated put back to Portland and the insurance surveyor at Portland recommended her removal to drydock. At that time no accommodation for a ship of her size was to be found within several hundred miles of Portland, which meant serious delay.

The chief engineer had a suggestion to make and, after consultation with the surveyor, was allowed to try his hand on the job, assuming all risk, however. A quantity of oakum was prepared and sufficient bolts and nuts of the diameter of the rivets procured; gromets were made to make the bolts tight when screwed up. Terms were made with a diver for his services, and the repair proceeded.

The heads of the rivets inside the ship were sheared off with hammer and set—one rivet at a time—and punched through, the diver inserting the bolt through each hole as made. A gromet and washer were slipped on, and the nut screwed up inside the ship. Oakum was used where it could be calked in the seams before the nuts were finally tightened.

When the whole of the seams that leaked had been treated, some leakage remained which was stopped by filling the bilge on that side of the ship with concrete, having under it at the bottom a perforated pipe protected from the cement by sheet iron; the end of the pipe led inside the tank to drain it. The steamer completed her charter, and the temporary bolts—now rusted in solid—were removed and the plates straightened and riveted in Antwerp, to which port she caried a cargo. This repair—as effected—must have saved some hundreds of pounds sterling.

London, Eng. A. L. HAAS.

Lathe Design and Practice.

The analysis of the different features of the engine lathe by E. H. Fish reminds me, as no doubt it does one of your associate editors, of a series of "ten-minute papers" prepared for the students in the mechanic-arts course at Cornell, and published in the *American Artisan* about thirty years ago, in which a similar course of reasoning was gone through.

In the article at page 527, Mr. Fish refers to setting the tool above the center. I pointed out long ago that it is not a question of the tool at all, as the tool, so far as itself is concerned, could be shaped so as to have the same clearance and cutting angle and be set anywhere around the piece being turned; but if shaped so as to have the proper clearance and cutting angle, and set below the center with a freely moving slide and looseness in the screw, the tool would hog in as soon as it began to cut; and it was this, I believe, that led to the forging of the tool to set it above the center so the action would tend to take up all slack.

It may be that with modern lathes, having heavy, well-fitted cross-slides, the tool may be set level with the center; but with very acute tools and soft stock it would seem to be possible for the tool to draw in. Mr. Fish has shown by far the best plan I have seen for guiding the cross-slide, but he detracts from its merits when he says: "So that re-scraping the packing side is all that is necessary to straighten up the slide after it is worn." There is no earthly reason why it should be made so as to wear loose in any place. If the slide is made as long as it ought to be, and the guide cut off as short as it ought to be, it would never wear in one place more than another.

Take a well-known 30-inch lathe, which will swing 32 inches, the sliding block is 20 inches and the guiding surface 38 inches; hence the sliding block can travel 18 inches, 2 inches more than necessary to face the largest piece that can be turned, without overrunning at either end and always have a bearing the full 20 inches.

The two scraped surfaces together are 58 inches long. If half of this be put in the slide-rest and the sliding block be made the same length, 29 inches, in the mid-, or most-used position, the block will have nearly 29 inches bearing, and when moved the distance necessary to face the largest piece the lathe will turn, it will at either extreme position overrun 8 inches and have 21 inches bearing, or 1 inch more than as made, with the advantage that it will in all other positions have more, that it will be better protected against chips, dirt and bruises, and that it will never wear loose in any one place, and so never need refitting.

Any piece of machinery that wears so it has to be refitted always gets too bad to use before the refitting is done.

The tool-holder he describes, which is like many of the English make, does not seem to me to possess the merits of the Lipe tool-post, which permits of the tool being raised and lowered and turned around after it is made fast. If the tail end of his holder is longer than the part that clamps the tool, he can get more grip than the single screw; but the grip is divided between two points, and two screws in the place of the two points are better. The Lipe post can have the two screws as well as one, and for boring it has two screws.

I anticipate that Mr. Fish will come back at me and say I sacrifice rigidity for convenience; but if the Lipe post shows weakness, it is only because it isn't half large enough; the slide, as in all American lathes, is too narrow. Although the Lipe post can be raised and lowered and turned, it does not add a loose joint, for, when in the required position, it is bound fast, as is the turning joint of a com-

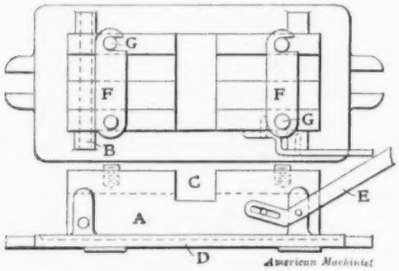
pound rest; and as to the additional joint for a taper attachment, I see no necessity for that. If the cross-feed nut is attached to a sliding bar, which can be made fast to the slide-rest for regular work, and when released from the work made fast to the taper attachment, no additional loose joint is introduced.

JOHN E. SWEET.

Keyseating Fixture for the Milling Machine.

The sketch shows a handy fixture for holding different sorts of shafting, round bearings, etc., while cutting keyseats for the Woodruff system of keying. This fixture is convenient for holding studs, or short pieces of shaft, part of which may run in bearings or have gears on one end, and, in fact, can be used in cutting the Woodruff keyways in any round piece which will go between the binding studs and which is not more than 4 or 5 feet in length.

A fixture of this sort does away with a good deal of the uncertainty which is



KEYSEATING FIXTURE.

connected with raising the knee of the milling machine when making this form of a keyseat. When raising the knee with the work strapped to the table, there is no give whatever, and too rapid a movement of the knee, or a sudden turn of the horizontal feed handle, is liable to cause the cutter to break; while with the work held in the fixture, the up feed is entirely controlled by the lever, and any uneven motion of the cutter is followed by the work, thereby lessening the breaking of cutters.

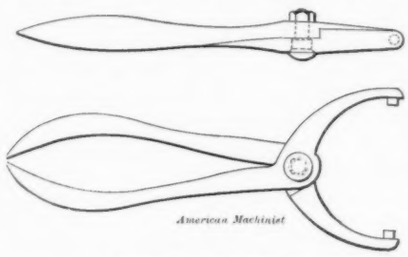
Referring to the sketch, *A* is a solid block with a V-groove machined its entire length for holding the work. It has a pin *B* running through one end and through the two supporting lugs. It is a snug but moving fit between these lugs or bosses and also between the two at the other end. *C* is a slot machined crosswise for receiving any thin shoulder on the work. The base *D* has two pieces of keystock fastened to it to fit the T-slot in the milling machine table. The lever *E* moves the body *A* up and down for keyseating the work when the latter is in place."

F, F are two straps on studs *G* for binding the work. Nuts go on each stud, and there should be a coil spring under the pivoted end of each clamp to keep it from sliding down the stud when the work is removed.

C. J. S.

Double Pin Spanner.

We have been using the vertical miller to bore holes in our large jigs, and find it well adapted to this work; but many changes of drill collets require frequent use of the pin spanner wrench, and the result is the pins shear off and put the spanner out of commission. Believing that two pins are stronger than one, we made the wrench here shown, and am happy to say it solves the problem for all screw collars having holes opposite. You see, the harder you pull the more the pins are forced into the holes. It can also be used for several sizes, although for hard service we would not recommend a range of more than ½ inch in diameter. We also tried a form of spanner with pins at an angle of 120 degrees for use with collar nuts having three holes, but found it not nearly so good as one having pins opposite. We were careful to make both legs alike, so that they could be made in the same former.



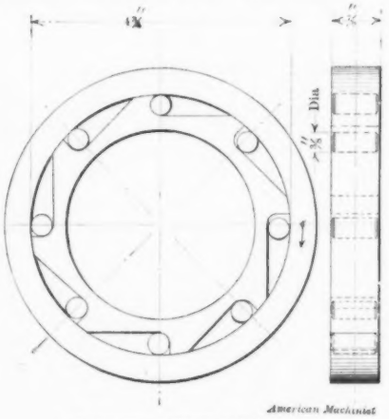
DOUBLE-PIN SPANNER.

ISAAC MORGAN.

Ball or Roller Ratchets.

I have been making some experiments on ball or roller ratchets, and enclose drawings of same, front and end elevation.

I am anxious to obtain information through the columns of your paper from mechanics who have had experience with similar ratchets as to the proper angle for the recess cams, and which would be preferable, rolls or balls for reciprocations at the rate of 250 strokes per minute?



BALL OR ROLLER RATCHETS.

It is understood, of course, that the outer ring is secured in a proper casting to hold the same in proper position, and it is this outer ring that reciprocates 1 inch movement, and it in turn gives motion to the cam ring which is secured to a proper shaft.

Would this construction be durable at the high reciprocation mentioned without lubrication?

Would the balls or rolls readily grip, or seat themselves if lubricated, especially after standing over night in cold weather and the lubrication should become hard?

I think possibly that among your many readers some of them might have had experience with this style of ball or roll ratchet; if so, any information or criticism is solicited.

G. C. H.

A Curious Drill-Shank Fracture—A Socket for Tangless Drills.

The photograph, Fig. 1, shows a curious fracture of a 2-inch twist drill. The drill was twisted off at the shank, and the tang was also twisted clear off. The break is

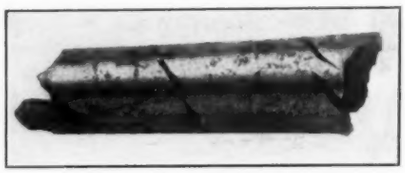
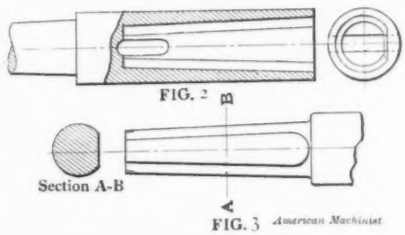


FIG. 1. THE BROKEN DRILL SHANK, SHOWN HALF SIZE.



SOCKET FOR TANGLESS DRILLS.

full length of the shank and in the form of a single spiral crack. Evidently the fracture must have started at the tang and run down toward the drill. The latter was not damaged at all; it was a new drill, regular shank, standard length. I have often wondered why twist-drill manufacturers use a shank on a 19-32-inch drill that is none too large for a ½-inch drill, and a No. 3 on a 1¼-inch when it is only large enough for 15-16-inch; and so with all regular-size shanks. It seems to me that the large end of the shank should be no smaller than the size of the drill it drives. You will note that the broken drill shank was a No. 4 standard Morse taper.

The sketches, Figs. 2 and 3, show the way our toolmaker used up the scrap pile of drills with tangs twisted off. The sockets are first cut off to length and bored out about 1-16 inch smaller than size. A plug is then made the same size and shape as the shank shown in Fig. 3. The socket is then heated and the plug forced in, opening the hole to size and forming the flat as shown. Having a

similar plug fitted to the lathe spindle, the socket is placed on it and the outer end centered, after which it is finished up in the usual way. W. T. H.

Ghost Lines.

Just how the name "ghost line" originated I am not able to say, unless it be owing to its mysterious appearance. I can, however, vouch for the fact that more than one person has literally felt a cold shiver at the sight of these uncanny visitors, for they consign to the scrap-heap most things in which they happen to be located.

I remember a large crankshaft that was rejected some years ago solely because of ghost lines, and that at the time no one seemed able to account for their appearance. Since this time I have again had cause to remember these mysterious visitors, and desire to know more of their habits. So far I have managed to pick up a few fragments of information on the subject, which I give for what they are worth.

On analysis it has been found that the metal composing the ghost line itself has a much higher percentage of phosphorus and sulphur than the surrounding parts of the same article, this being especially the case with phosphorus, so that the moral is to avoid sulphur and phosphorus (which, indeed, is now practically an axiom among steelmakers).

Another interesting point is that occasionally certain forgings which, after rough turning, have shown no trace of ghost lines, have, after annealing and finish turning, fairly bristled with them, the slow cooling during annealing apparently being in some way responsible for their appearance.

Perhaps some readers of the AMERICAN MACHINIST may be able to throw light on this subject, which is of considerable interest to me, and doubtless to many others who have "seen a ghost."

WESTREE.

A Setting Jig For a Bracket.

At one time considerable difficulty was experienced in a certain works in setting correctly on the column of a machine, the bracket shown at *A*, Fig. 1. The machine column is shown at *B;* and it is necessary that dimensions *a* and *b* be absolutely correct and the height of screw holes 1 and 2 from the base line must also be right. All holes are drilled in jigs, but it was found that owing to the awkward shape of the bracket, which may possibly have been sprnng a little in machining, it was a very difficult matter to set all alike, and as a large number were to be made it was thought worth while to provide the rig shown.

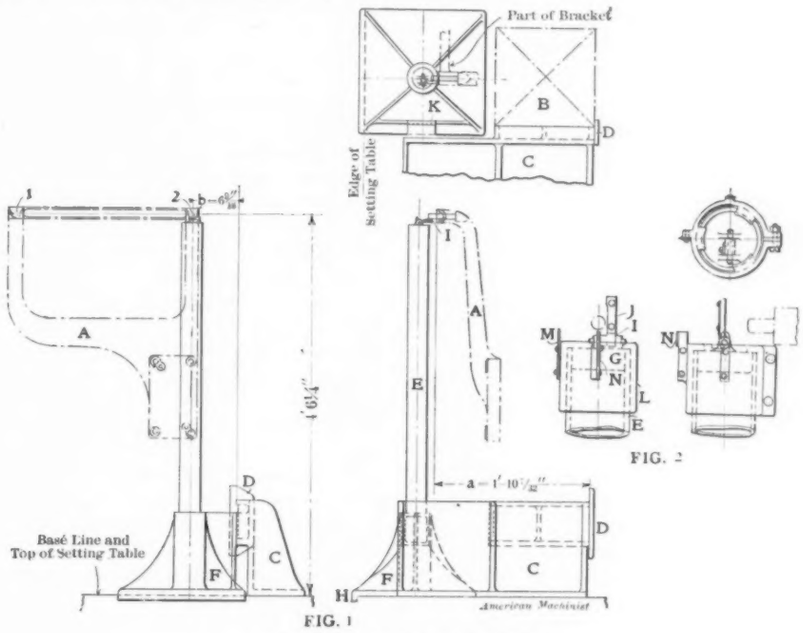


FIG. 1

A SETTING JIG FOR A BRACKET.

FIG. 2

At first, a considerable amount of fun was made on the subject of the "lighthouse," as it was christened, when the apparatus was completed in the toolroom and sent to the shop where these parts were assembled.

However, after using it a short time, the men found it a very great help in making the job right, and when a larger size machine of a similar kind was made, they were asking for a new "lighthouse" of suitable dimensions before it could be completed, and as the original one has been used to set approximately 3,000 brackets, it has seen good service and paid for itself.

A special angle plate *C*, with an end-stop plate *D* was fixed on a planed table at the correct distance from the edge. This angle plate has bolt holes for fixing the column *B* against it.

A piece of steel tube *E* (Figs. 1 and 2) 3 inches diameter and of the proper length was turned at both ends, and the bottom end was securely pinned into the gray-iron casting *F*. The under side of the casting was turned so that the tube would stand vertically, and a plug *G* was fixed so that it was just within the top of the tube. A strip *H* was provided to come against the edge of the table, but it would probably be better to make this run in a groove so that casting *F* could not be accidentally moved away.

A short brass lever *I*, Fig. 2, with hardened "feeler" *J* was pivoted in *G*, and when face *K* of casting *F* is brought up against the projecting portion of angle bracket *C*, the feeler should touch the side of a turned pin projecting from hole 2 in the top of the bracket. If this is the case, dimension *b* is known to be correct.

To test the other size, *a*, and the height, the brass casting *L*, which has "feelers" *M* and *N*, is used. *L* is a nice fit on the outside of the tube and is moved round by hand as required; and the three projecting ears rest on the top of the tube. Feeler *M* is used for testing under pins 1 and 2, thus checking the height from the base, and *N* tests the distance from the edge of the table, thus insuring dimension *a* being correct at both sides of the bracket.

It will be noticed that *I* is provided with a heel so that it will stand upright when *L* is being used. By means of the "feelers" great accuracy can be attained, and after the various dimensions are found correct, taper pins are put in in the usual way.

Coventry, Eng. F. C. DOLBY.

Devices That are Failures, and Making Things Work.

U. B. S.'s article, "Making Things Work," at page 570, invites some criticism.

It seems that it was the adjunct of the spring to the milling device, and not the admonishment of the workman, that made the thing go, and that the device was defective and incomplete without the spring. I must say, however, that the man at the machine lacked the spirit of observation that marks the true mechanic, or he would have discovered the reason why the device wouldn't work.

Having been in contact with machinists eighteen years, the first twelve as a machinist myself, I can say, from my own experience, that first-class men, who are machinists by vocation, are right 99 times out of 100 in their verdicts, and that it is their natural ambition to do all in their power to make things go and not to kill jobs.

I am also in a position to say, and to prove, that while selected mechanics are not very plentiful in machine shops, selected foremen are just as scarce, and that very often scheming and attempts to improve result in loss of time, naterial and money.

The device that was a failure, described

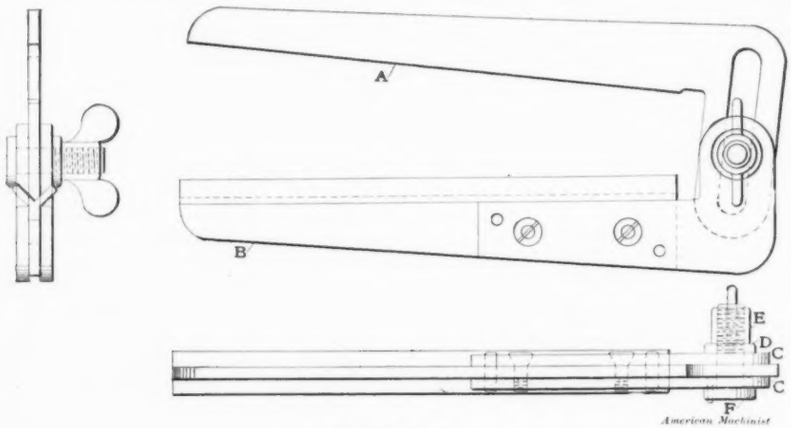
at page 506, anyone will admit, was conceived by an inexperienced and unskilled mind, and was doomed to failure the very moment it was conceived, and it was not killed by me but simply died a natural death for lack of soundness.

J. M. MENEGUS.

A Taper Gage.

The illustration shows an adjustable taper gage for trying the tapers on lathe centers, taper pins, plugs, milling machine arbors, etc., while undergoing the operations of turning and grinding. When turning and grinding tapers with the aid of this gage the accuracy or deficiency of the work is more readily detected than if tried with a taper hole gage and a piece of chalk or Prussian blue. The gage is set to a plug or a piece having the required taper, and when the piece under operation is tried with it its state of accuracy is seen at once and need not be guessed at.

The blade *A* and the Y-shaped piece *B*, which is part of the body, are made of tool steel and of a size to suit the require-



A TAPER GAGE.

ments, and the working faces are hardened and ground. The lobe of the blade containing the elongated hole is fitted closely between the two pieces *C C*, which are made of cold-rolled bessemer steel and are fastened to the Y-shaped piece with two screws and two dowels. The washer *D*, the winged nut *E* (a winged nut is preferable to a nurled nut because it offers a better grip for tightening) and the clamping screw *F* complete the gage. Through the head of the clamping screw a small hole is drilled, into which is driven a small pin long enough to project some distance from its under side and to allow it to enter a hole of the same size drilled into one of the side pieces *C*, to prevent the clamping screw from turning when the winged nut is tightened while setting the gage.

The durability and appearance of this tool are heightened by giving the blade, the Y-shaped piece and the side pieces a bright finish (not polished), and the bevel head screws and the two dowels for holding the side pieces are made long enough to allow their rounded, polished and blued heads and ends to project from either side. The clamping screw, washer and winged nut, which are made of bessemer steel, are case-hardened, and the two former are repolished and blued, while the latter is allowed to retain the color and temper it acquired in the hardening.

H. E. R. MANBRAND.

Making Things Work.

The article at page 570, entitled "Making Things Work," while an old story to anyone who has tried to introduce new appliances, nevertheless illustrates a condition which occurs every day. New tools and appliances are constantly opposed by the men that are to use them, and many a valuable tool has been "killed" by the operative. When pneumatic calkers were first introduced in a certain shipyard and when it was found that one man could do the work of three or four, the men discovered that they could not follow the seams with them. The tools wandered all over the plate and were about to be abandoned, when the master mechanic devised a guide for keeping them to the work. When the men found that the tools would be used anyway, they discarded the cumbersome guides, and there has been no trouble since.

F. W. HARRIS.

A dam was formed on the Canadian side of Niagara Falls the other day by an ingenious, and to us, new method. A concrete column was built on a staging at one side of the water it was proposed to dam, and when this column was complete, it was tipped over into the position it now occupies, and the operation was successful. The column was 7 feet 4 inches square and stood 50 feet high on a trestle 20 feet above the ground level. The plans for this work were prepared by Isham Randolph, of Chicago.

Steel fly-wheels having a tensile strength of 60,000 pounds per square inch will stand a speed 90 per cent. greater than fly-wheels made of gray iron.

Some Features of a Large Blowing Engine.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show some features of a blowing engine which was installed recently for the Longdale Iron Company, of Longdale, Va., by the Nordberg Manufacturing Company, of Milwaukee, Wis. The machine will be seen to be of an unusual type for this purpose, being designed on air-compressor rather than the usual blowing-engine lines. It is of the horizontal duplex type, with compound steam cylinders, and has the, for this purpose, entirely novel feature of positively moved Corliss valves for the air cylinder, in which respect again it follows the regular air-compressor practice of the builders. The steam cylinders are 26 and 48 and the air cylinders 62 inches diameter, the stroke being 42 inches. The machine is intended ultimately to use a steam pressure of 120 pounds, to make a blast pressure of 7 pounds, and to run at a speed of 75 revolutions, delivering 20,000 cubic feet of air per minute. At present, however, the steam pressure is 70 and the air pressure 4 pounds, while the speed is but about half that for which it was designed, the reduced speed and pressure being due to the fact that intended changes in the blast-furnace plant have not yet been made. The intended speed is, of course, high—very high for a blowing engine—and in the design the reciprocating parts have been given such a weight as to act as an equalizer of the varying pressures—this being, probably, the first case of a blowing engine in which that has been done. In order to provide for emergencies the machine and its pipe connections have been so designed that either side is operative without the other.

The general design will be apparent from the plan, Fig. 1, and the side elevation of the high-pressure side looking from between the cylinders, Fig. 2. The air cylinders will be seen to be next the frames. A point of leading interest is the Corliss valves used on the air cylinders which are essentially the same as those of the steam cylinders, except that their functions are reversed, the inlet air valves being similar to the exhaust steam valves and the outlet air valves similar to the admission steam valves. All valves are double-ported, a provision which gives to the air valves the unusually generous effective port area of 13.4 per cent of the piston area. Sectional elevations of the air cylinder are shown in Fig. 3, the general layout of the valve gear being shown in Fig. 2, while Fig. 4 shows the valves in relation to their seats and the method by which the inlet valves are given a double port. Fig. 5 shows the corresponding construction of the steam valves, including the layout of their movements. Referring to Fig. 3, spring-

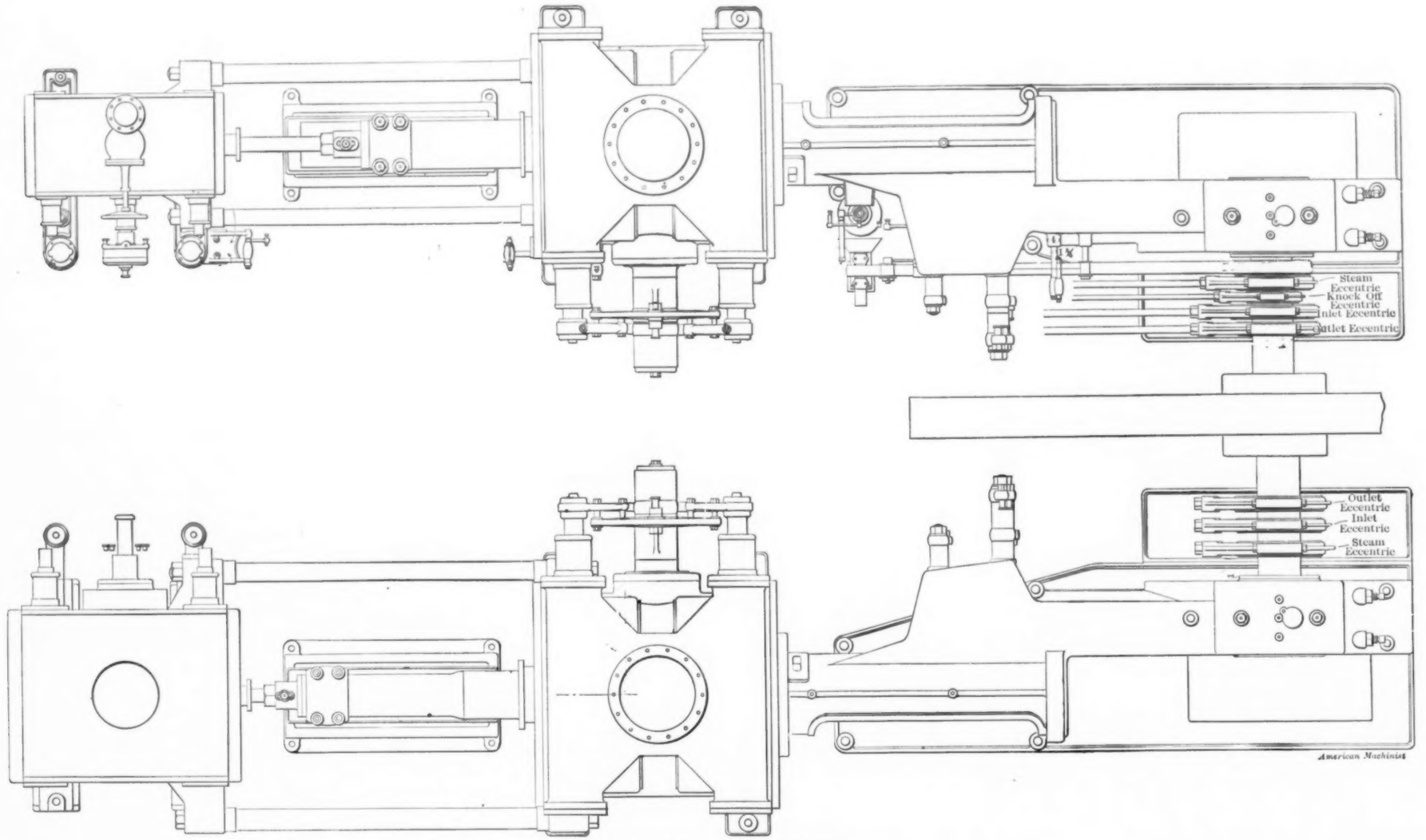


FIG. I. PLAN OF BLOWING ENGINE.

closed relief or safety valves are located at *a* to provide for any possible failure of the regular valves to act. It will be understood that the air valves being positively moved, two eccentrics are used. A feature of air-valve gear by which adjustment is obtained is shown in Fig. 6. Instead of adjusting the length of the radius rods to the wrist-plate a hub *a* is here keyed to the valve stem. This hub has squared seats *b c*, against which the ends of adjusting screws *d e* bear. It is obvious that these screws enable the valve to be adjusted with great nicety, a clamp bolt *f* serving to bind the parts in their final positions.

The releasing gear is of the Nordberg full-stroke type, in which the releasing is done by cams operated by a special eccentric, these cams serving to engage the hooks as well as to release them. The general construction is shown in Fig. 7. The arc-shaped releasing and engaging cams are clearly shown, as well as the

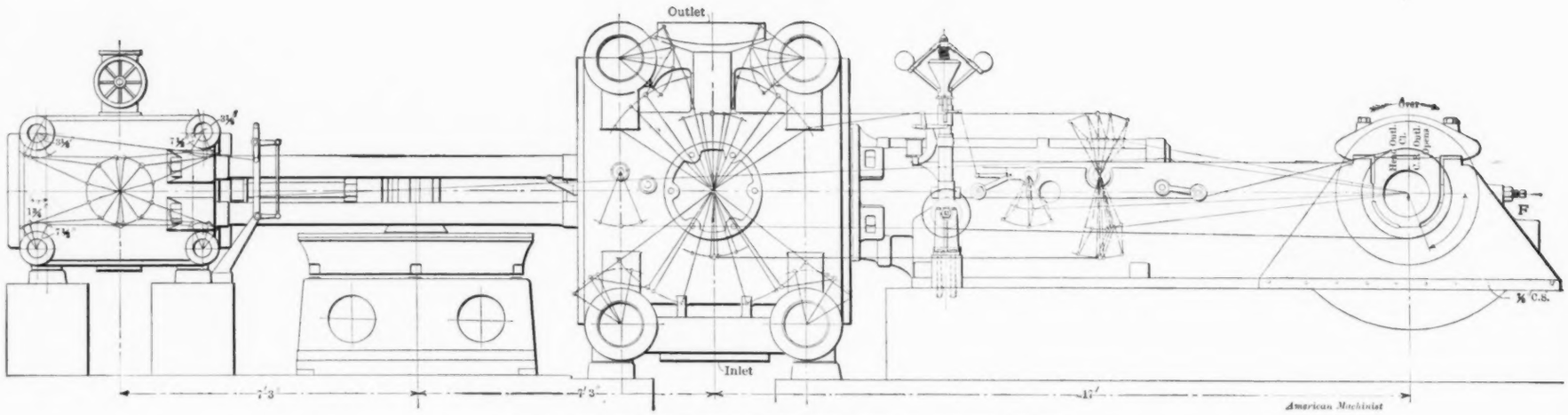


FIG. 2. SIDE ELEVATION OF HIGH-PRESSURE SIDE OF BLOWING ENGINE.

swinging frame at the right by which they are driven. This feature, together with the method of connecting the cams to the governor, is better shown in Fig. 8. The two reach rods to the releasing cams, shown in Fig. 7, are connected at *a b*, the eccentric rod being connected at *c*. Arm *d* is keyed to the same shaft as *a b* and is connected by a link *e* to arm *f* of a bell crank, of which *g* is the other arm, and to which, at *h*, the governor reach-rod is connected. It is obvious that under the action of the eccentric rod the parallelogram of parts will oscillate as such, the arm *a b* maintaining a vertical position and giving equal movement to both knock-off cams. Should, however, the governor draw pin *h* to the right, the link *l* will drop, *a b* will be inclined to the right and the parts will, as before, oscillate as a parallelogram, *a b* swinging in its inclined position but maintaining its parallelism with itself while the two ends have again the same movement.

Fig. 9 shows the speed-varying device. The shaft of the governor belt pulley *a* has an internal cone *b* which drives an external cone *c* on the governor spindle *d* by means of an intermediate friction disk *e*. The shaft of the disk is supported by a sliding quill *f* having rack teeth cut upon it with which a pinion meshes. Attached to the pinion shaft is a hand-wheel, by turning which the speed is adjusted. A spring *g* maintains pressure between the friction surfaces. It will be observed that the bearings of the intermediate disk sustain no pressure. The ratio between the highest and lowest speeds given by the device is 3 to 1.

Fig. 10 shows a favorite construction of Mr. Nordberg's for supporting the pistons of large low-pressure cylinders, of which the pistons have of necessity a weight out of all proportion to the work which they have to do. When the slight deflection of a piston rod which suffices to transfer its weight to the cylinder is considered, the conclusion seems inevitable that the mere provision of slides at both ends of a rod of usual proportions is incapable of much effect in this direction. In the present case the low air pressure removes the objection to a large stuffing-box and hence the rod is made of enormous size—16 inches diameter—is a casting, and of course is hollow. Within this cast rod is a forged rod, the two being so connected that the forged rod carries the tensile and the cast rod the compression strains. A key at *a* serves to put the forged rod under initial tension. F. A. H.

Motors For Various Sizes of Machine Tools.

The following table from the *Electrical World and Engineer* gives the power ratings of motors which have been operated on the machine tools named:

Niles 96-inch driving-wheel lathe, chain connected, 10 horse-power.

Group, overhead belted. Niles 42-inch engine lathe, emery wheel; Craven quartering machine, 5 horse-power.

Niles double-axle lathe, chain connected, 7½ horse-power.

Niles 48-inch car-wheel lathe, chain connected, 10 horse-power.

Sellers planer, 54x54 inch, belted overhead, 10 horse-power.

Niles 8-foot boring mill, chain connected, 10 horse-power.

Niles 8-foot wheel lathe with quartering attachment, variable-speed motor, chain connected, 10 horse-power.

For driving quartering attachment to this lathe, two motors, chain connected, each 3 horse-power.

Fairbain, Kennedy & Naylor 72-inch driving-wheel lathe, belted overhead, 7½ horse-power.

Putnam 79-inch driving-wheel lathe, belted overhead, 7½ horse-power.

Niles 96-inch driving-wheel lathe, chain connected, 10 horse-power.

Group, belted overhead. Becker Brainerd No. 6 vertical miller; Becker Brainerd No. 7 vertical miller; emery wheel; Niles 30-inch shaper; Bement-Miles No. 2 cotter drill; Niles vertical boring mill; Niles 24-inch drill press; Niles 4 spindle drill, 15 horse-power.

Niles double-axle lathe, chain connected, 7½ horse-power.

Niles 48-inch car-wheel borer, for driving tool, chain connected, 7½ horse-power.

For driving hoist—geared, 3 horse-power.

Niles 48-inch hydraulic wheel press, belted overhead, 5 horse-power.

Group, belted overhead. Niles 6-spindle drill; Niles 24-inch shaper; Bement-Miles 15-inch slotter; Niles gap lathe 24x48 inches; Niles lathe 28 inches by

14 feet; Niles lathe 18 inches by 8 feet, 15 horse-power.

Bement-Miles 18-inch vertical slotter, chain connected, 10 horse-power.

Tool-room group, belted overhead. Brown & Sharpe milling machine; S. C. Wright 16-inch lathe; Bement & Son 9-inch shaper; Niles-Bement-Pond Company 20-inch lathe, 10 horse-power.

Group, belted overhead. Pond engine lathe, 36 inches by 17 feet; Pond engine lathe, 36 inches by 20 feet; Niles engine lathe, 30 inches by 16 feet; Gisholt universal tool grinder, 10 horse-power.

Niles-Bement-Pond Company 24-inch drill press, 10 horse-power.

Pond planer, 32 inches by 10 feet, belted overhead, 5 horse-power.

Niles 30x30-inch planer, geared, 5 horse-power.

Group, belted overhead. Gisholt 34-inch turret lathe; Niles No. 2½ horizontal

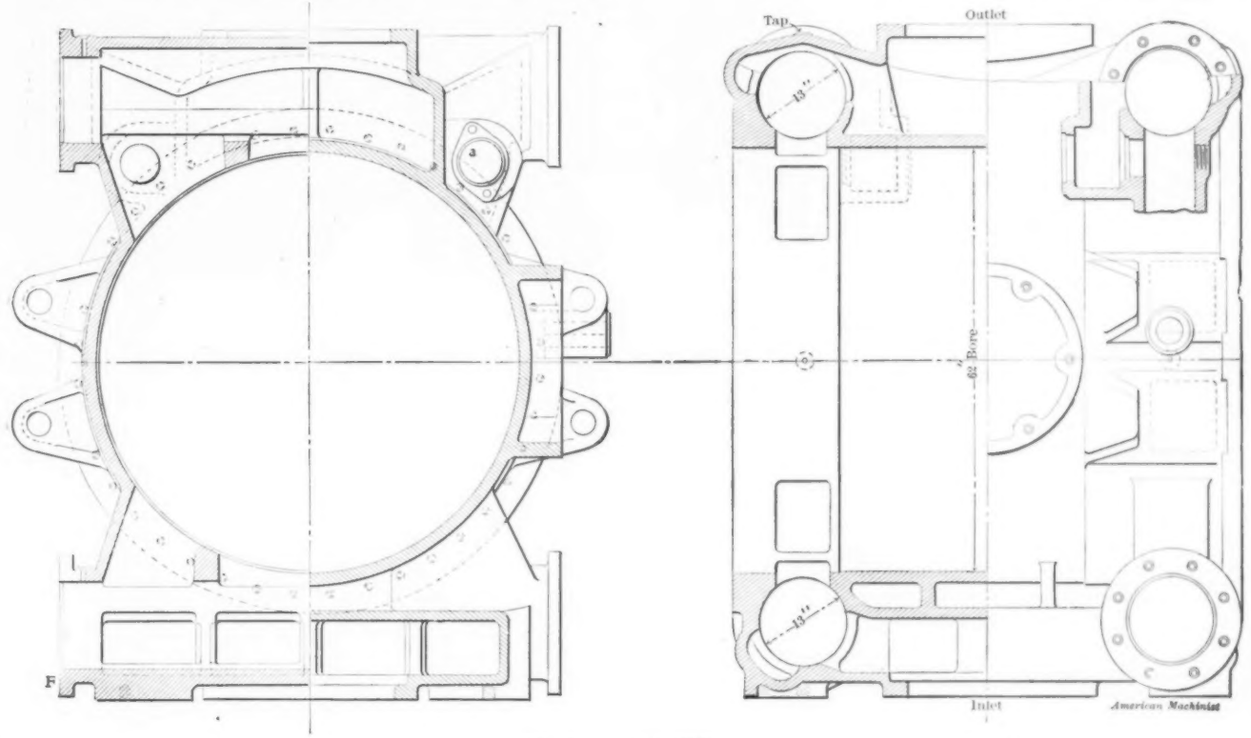


FIG. 3. AIR CYLINDER.

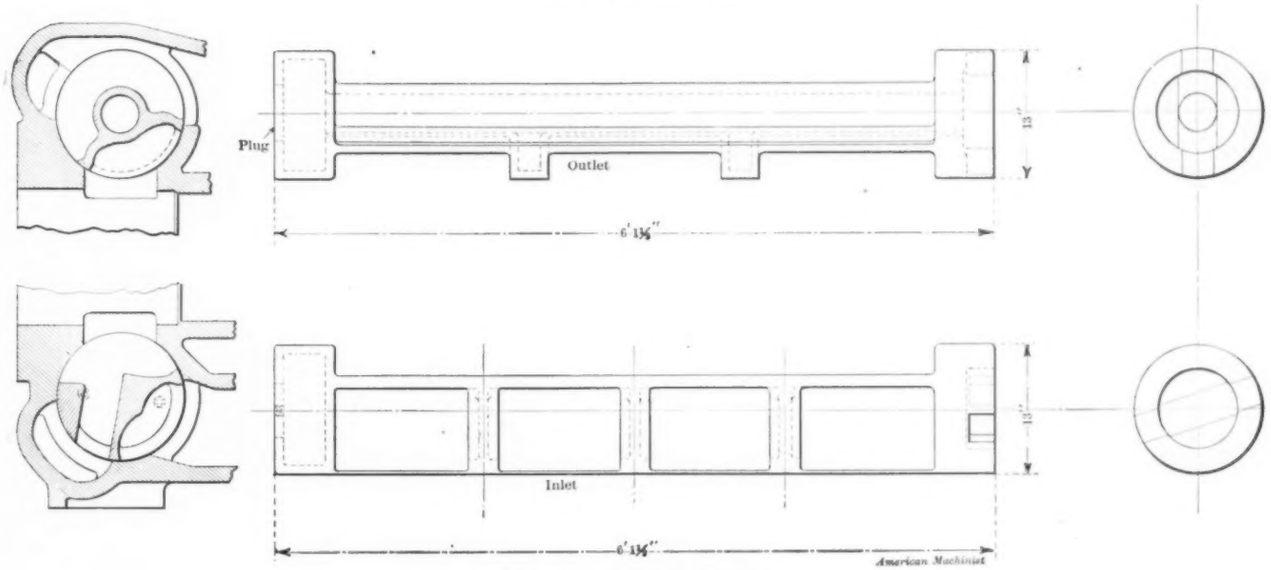


FIG. 4. AIR VALVES AND SEATS.

No. 2 milling machine; Niles-Bement-Pond cutter grinder; Sellers twist-drill grinder, 7½ horse-power.

Niles 7-foot boring mill, belted overhead, 7½ horse-power.

Group, belted overhead. Bement 32-inch drill press; Lodge & Davis 22-inch lathe; Gisholt 21-inch turret lathe; Niles-Bement-Pond Company 20-inch lathe, 10 horse-power.

Group, belted overhead. Niles spindle drill; Newton cold saw; Niles-Bement-Pond lathe, 20 inches by 10 feet; 3 Jones & Lamson turret lathes, 2x 24 inches; Gisholt 24-inch turret lathe; No. 2 water emery wheel, 15 horse-power.

Group. Gisholt 28-inch turret lathe; boring mill; Niles 22-inch lathe; Lodge & Davis 18-inch lathe; Le Blond No. 3 milling machine, 15 horse-power.

Group, belted overhead. Niles 20-inch shaper; Niles-Bement-Pond Company 12-inch pipe machine; Niles 16-foot radial drill press, 5 horse-power.

Niles 60x60-inch planer, overhead belted, 15 horse-power.

Pond 48x48-inch planer, chain connected, 10 horse-power.

Niles 60-inch horizontal boring mill, variable-speed motor, chain connected, 3 horse-power.

Group, overhead belted. Brass room, Lodge & Davis lathe; 2 Niles 18-inch lathes; 2 Fox 18-inch lathes; 2 Niles-Bement-Pond Company 18-inch lathes; 2 Fox 16-inch lathes, and emery wheel, 10 horse-power.

Group, belted overhead. Niles lathe, 28 inches by 14 feet; Wm. Bement 16-inch slotter; Wm. Bement 12-inch slotter; 2 Niles lathes, 26 inches by 12 feet; Niles 24-inch shaper; Bement-Miles 12-inch shaper; Springfield Manufacturing Company's No. 5 oscillating surface grinder; Springfield Manufacturing Company's face and variety grinder, 15 horse-power.

Group, overhead belted. Pond lathe, 28 inches by 20 feet; Niles-Bement-Pond 21-inch drill press; Niles screw machine; Niles engine lathe, 36 inches by 16 feet; Bement 24-inch drill press; No. 2 water emery wheel; Niles 18-inch extension lathe; Fitchburg 32-inch lathe; Bement 50-inch drill press; centering machine, 15 horse-power.

Niles 30-inch double-headed shaper, belted overhead, 5 horse-power.

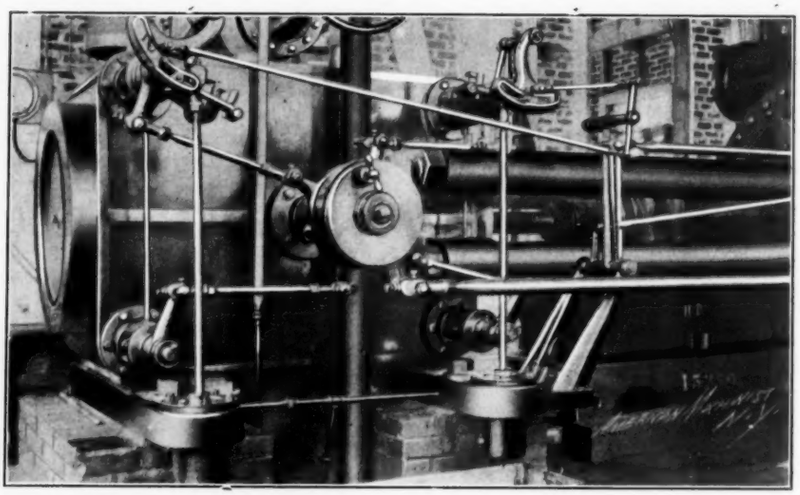


FIG. 7. NORDBERG FULL-STROKE VALVE GEAR.

Group. Niles 7-foot plate-bending roll; Ajax 12-foot plate-bending roll, motor on floor, chain connected to countershaft and belted to tools, 20 horse-power.

Kneeland No. 1 R lever shear for 1¼-

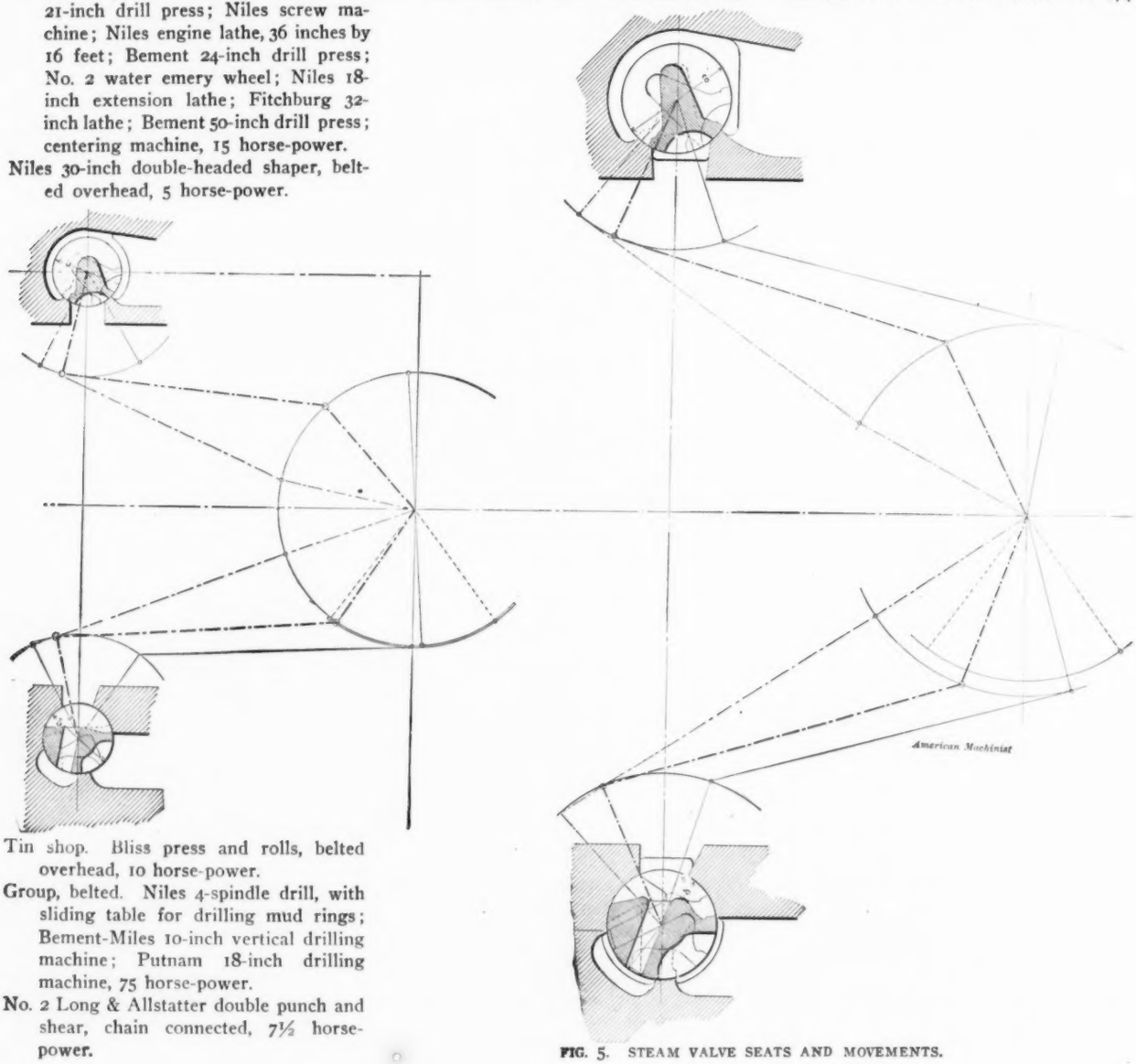


FIG. 5. STEAM VALVE SEATS AND MOVEMENTS.

Tin shop. Bliss press and rolls, belted overhead, 10 horse-power.

Group, belted. Niles 4-spindle drill, with sliding table for drilling mud rings; Bement-Miles 10-inch vertical drilling machine; Putnam 18-inch drilling machine, 75 horse-power.

No. 2 Long & Allstatter double punch and shear, chain connected, 7½ horse-power.

inch square steel, belted overhead, 5 horse-power.

Lloyd Booth No. 6 lever shear for scrap, geared, 7½ horse-power.

Williams, White & Company's No. 2 bull-dozer, geared, 5 horse-power.

Ajax forging roll, motor on floor, belted, 10 horse-power.

No. 10 Sturtevant steel pressure blower, motor on floor, belted to overhead countershaft, belted to blower, 40 horse-power.

Morgan double punch and shear, chain connected, 10 horse-power.

Newton No. 3 bar cold saw, chain connected, 5 horse-power.

Group. Blakeslee 1-inch forging machine; 2 Blakeslee 2-inch forging machines; 1½-inch forging machine, on floor, belted to overhead countershaft, 40 horse-power.

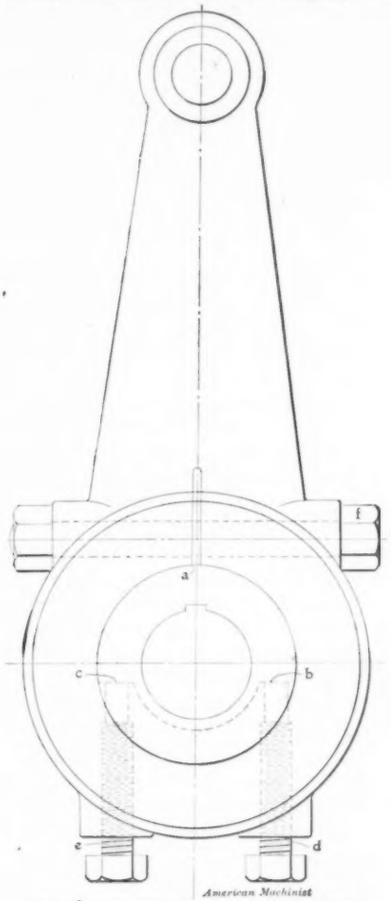


FIG. 6. ADJUSTMENT OF AIR VALVES.

Group. 2 Acme 1½-inch 6-spindle nut tappers; Oliver 8-spindle nut tapper; Asme 2-inch double bolt cutter; National 1½-inch double bolt cutter; Lewis & Oliver 1-inch double bolt cutter; 2 Acme 1½-inch double bolt cutters; Acme 5-inch single bolt cutter, motor on floor, belted to overhead shaft, Acme 1½-inch single bolt cutter, 30 horse-power.

Flue shop. 2 Hartz flue welders; combined flue cutter and tester, overhead belted, 7½ horse-power.

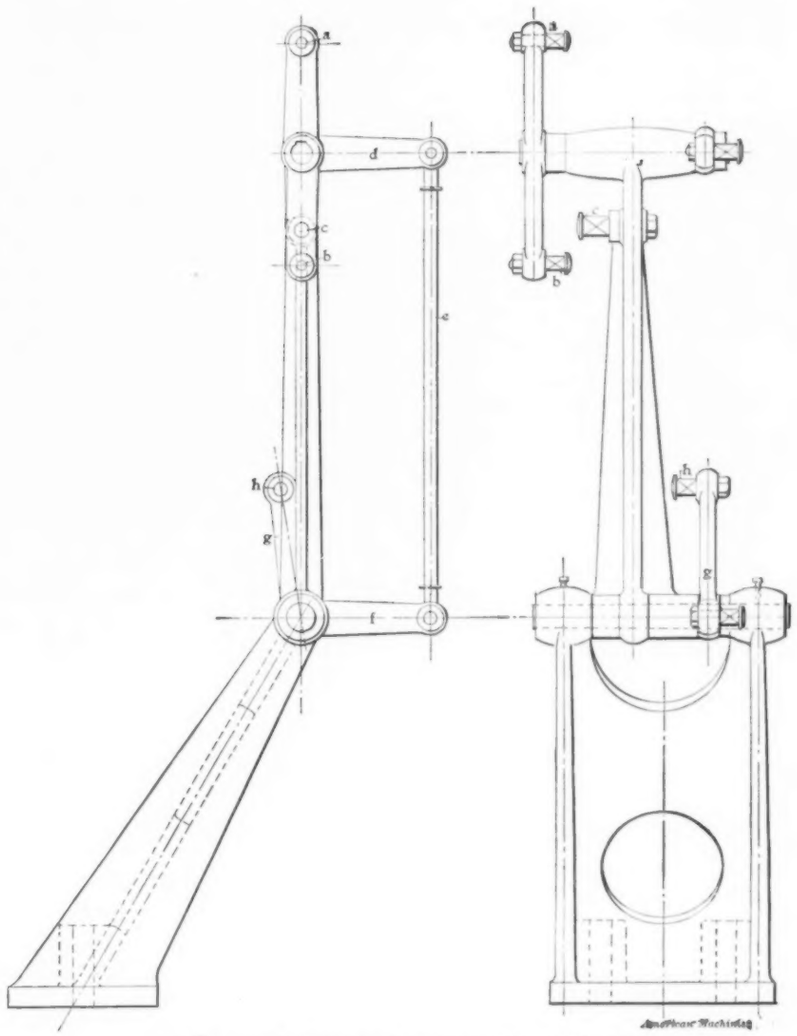


FIG. 8. ATTACHMENT OF RELEASING GEAR TO GOVERNOR.

Outdoor flue rattler, 34 inches diameter by 16 feet, motor on floor in separate inclosure, belted, 7½ horse-power.

Tank shop. Small Gramo Klausman band saw, overhead belted, 5 horse-power.

Physical laboratory. Testing machine, motor on floor, belted, 5 horse-power.

Brass foundry. 2 car-brass boring machines; Root positive blower; rattler; overhead belted, 10 horse-power.

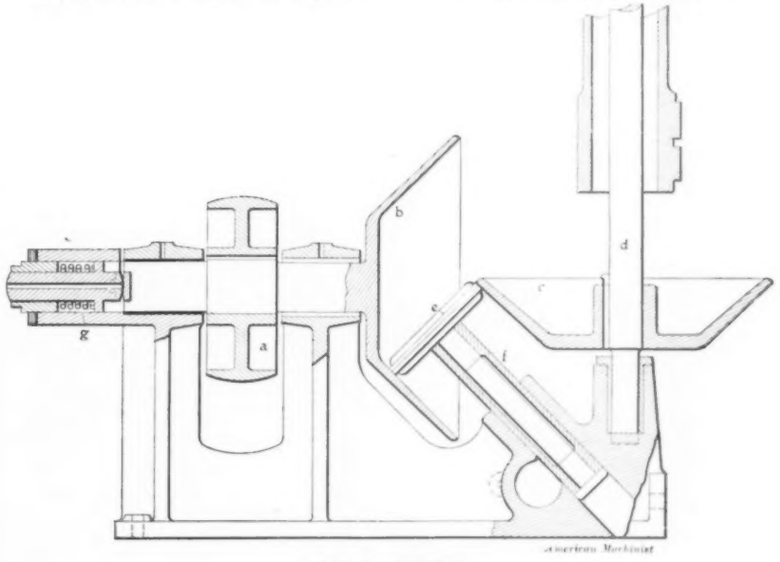


FIG. 9. SPEEDER.

Stores department. Incline, movable platform, variable-speed motor, chain connected, 3 horse-power.

The following list of approximate power requirements for various tools has been compiled by the Electro-Dynamic Company from data published from time to time in the several engineering magazines. In special cases power required may be several times the average values listed here:

BORING MILLS—VERTICAL.

34 and 36 in....	5 H. P.	6 and 7 ft.....	15 H. P.
42, 48 and 50 in.	7½ "	8 ft.....	20 "
60 in.....	10 "	10 ft.....	25 "

ENGINE LATHES.

12 and 14 in....	1 H. P.	42 and 48 in..	5 H. P.
16 in.....	1½ "	54 in.....	6 "
20 to 25 in.....	2 "	60 in.....	7½ "
28 and 30 in.. .	3 "	72 in.....	10 "
36 in.....	4 "		

DRILL PRESSES.

21 to 32 in.....	2 H. P.	50 to 60 in.....	5 H. P.
36 to 48 in.....	3 "		

PLANERS.

17 x 17 in. x 3 to 6 ft.....	4 H. P.
26 x 26 in. x 6 to 12 ft.....	6 "
42 x 42 in. x 10 to 12 ft.....	10 "
48 x 48 in. x 12 to 14 ft.....	15 "
50 x 60 in. x 14 to 18 ft.....	20 "
72 x 72 in. x 16 to 18 ft.....	25 "
22 x 24 in. x 4 to 8 ft.....	5 "
24 x 24 in. x 4 to 10 ft.....	5 "
30 x 30 in. x 6 to 14 ft.....	7½ "
36 x 36 in. x 8 to 16 ft.....	7½ "
42 x 42 in. x 14 to 18 ft.....	15 "
48 x 48 in. x 16 to 20 ft.....	20 "
60 x 60 in. x 20 to 22 ft.....	25 "
72 x 72 in. x 20 to 24 ft	30 "

SLOTTERS.

6 to 10 in.....	3 H. P.	16 and 18 in.....	7½ H.P.
12 to 14 in....	5 "	26, 30 and 36 in..	10 "

SHAPERS.

12 to 16 in.....	2 H. P.	28 to 30 in.....	6 H. P.
18 to 20 in.....	3 "	36 in.....	8 "
24 to 26 in.....	5 "		

A recent special issue of the *National Civic Federation Review* is devoted to a discussion of the question of public ownership of public works and enterprises, and in it are published articles and letters from very many prominent men, who discuss the question from both, or rather all, sides.

Professor Sweet's Artisan School.

We learn with great satisfaction that the school of trades which Professor Sweet has had near to his heart for many years is now in a fair way to be established. A stock company is to be organized with $50,000 capital stock, over one-third of which has been pledged. The charter is to be very comprehensive, covering all industrial arts, although the beginning will be made with a machine shop alone, the next step contemplated being the addition of a foundry. Several sites are under consideration, and a start will be made as soon as possible. The stockholders will receive no benefit excepting from the workmen they get in their work and the consolation it is likely to give them to see the thing made a success. The stock will be taken by people who want workmen and those who want to build up the city of Syracuse.

Professor Sweet is to give about one-half his time to the school *without charge*. With his hand at the helm, we have not the smallest doubt of the entire success of the enterprise. Following is a copy of a prospectus which has just been issued:

"The experience of the manufacturers has shown that there is a constantly growing demand for well-trained machinists, patternmakers and skilled mechanics generally. Owing to a combination of causes, it appears that the supply of such trained workmen is not keeping pace with the demand.

"The object of the Artisan School is to provide a shop in which young men may learn the art and acquire the handicraft necessary to meet the requirements of the employers engaged in the various industries established in this city. In addition to experience in practical work, it is proposed to give instruction in such studies as will be useful to the students in their future chosen employment, and such training in the duties of life as will make them useful and desirable citizens.

"In carrying out this plan, it is proposed to first organize a school shop fully equipped with machine tools, with the necessary drafting, study and lecture room attached, and thus to furnish the opportunity for instruction in all the necessary branches for young men, who will thus be enabled to become accomplished artisans along the lines which they have chosen.

"The instructors in the school will all be men of practical experience, and it is thought best to devote the major part of the time to practical work.

"It is proposed to operate the shop school on a commercial basis, meaning by this that the shop shall make articles which may be readily sold in the open market, that it shall do work for other shops, and shall actually make a large part of the necessary equipment for use within the school. It is believed that the enterprise can thus be made practically self-sustaining after it has been put in operation.

"To carry this plan through in a way which will insure permanent success, it is proposed to organize a stock company, the directors of which shall be men intimately identified with the employment of labor such as is taught in the school. The capital stock is proposed to be fixed in the sum of $50,000, divided into shares of $100 each. It is thought that one-half of this amount would be sufficient to make a good beginning, and possibly the remaining part of the subscription would not be called for some time.

"We appeal for the hearty co-operation and support of all those interested in the development of the manufacturing industries of Syracuse, and we believe that no more important step in assisting such development can possibly be taken."

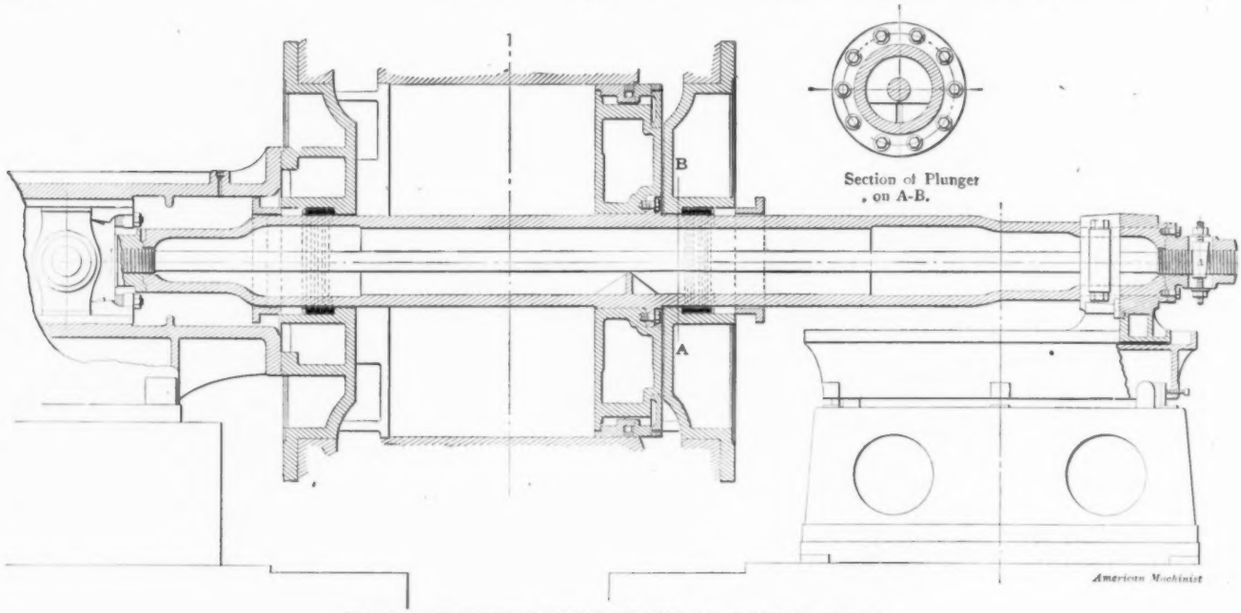


FIG. 10. SUPPORTING PISTON ROD FOR AIR-CYLINDER PISTON.

Foreign Markets For American Machinery.

It would be well for American manufacturers to seriously consider the altered conditions which now prevail in the Far East. Japanese influence will largely dominate Corea and Manchuria, and we shall witness an enormous expansion of trade in those countries. They are particularly rich in those resources needed for Japan's progress, and Japan will exchange them for her manufactured goods, which in their turn will be largely made by machinery purchased from foreign sources. Of course Japan makes a fair quantity of machinery of various kinds, but her manufacturers will not be able to supply all the plant needed. We shall see an instance of this in textile machinery, mill furnishings, scientific instruments, tools, railway material and appliances, steam engines, locomotives, etc. The Japanese are becoming more and more a manufacturing people, and the acquisition of Corea and control of at least part of Manchuria will give an enormous impetus to that progress, and consequently a proportionate demand for manufacturing plant. Apart from this Japan will bring a certain influence to bear in China, and that empire may eventually be brought into line with modern ideas, creating in its turn a gigantic commercial development of the Chinese market. Japan will of course be a formidable competitor with the United States and others in Far Eastern trade, but she can deal with only a relatively small portion of it.

There is a capital opening in Russia for small-sized stationary engines, traction motors, etc., using denaturated spirit as fuel, instead of petroleum. A great many estates own their own distillery, and as the production of rye spirit is not an expensive process, nor any government duty charged on it in its denaturated state, it is very likely that the land-owners and farmers will use spirit as fuel to work their farm machinery, and for transport purposes. I am informed that only one small-sized stationary motor of British make using spirit as fuel has been imported into the Kieff district, but that has proved very successful. The subject is worth the attention of engineering firms making a specialty of gas-forming explosive engines. In all probability a serviceable sized spirit-driven motor, powerful enough to work ordinary grinding mills, small threshing machines, chaff cutters, etc., would find a ready sale. There are also the small-sized tractors for ploughing and reaping machinery, which in itself opens up a field hitherto untouched in the Rusian Empire.

In Sweden the use of gas, gasolene and oil engines is largely on the increase, confidence in them having been fairly established. There is a large opening for these motors, especially where small power is needed. At present England, Germany, France, and the United States supply the demand, while a good many are made in Sweden nowadays. Of gas engines the suction-gas variety appears to be the leading favorite, and is generally used in sizes up to about 100 horse-power. They are mostly used in factories, and for electric power stations, but are also used for boats. The majority have until lately been imported from England and Germany, but the Swedes are manufacturing them at home now. They are all of the four-cycle type. Gasolene or benzin motors are generally of small sizes, such as 3, 5, or 7 horse-power, very rarely exceeding 40 horse-power. American manufacturers have hitherto supplied the bulk of them, but several Swedish firms have now begun building this class of motor. They are principally used in motor cars and pleasure boats; and are also of the four-cycle pattern. The most important opening, however, is in oil engines, which are used in all sizes from 1 to 200 horse-power. There are indications that their use will be very extensive, particularly in the case of fishing boats, small freight vesels, etc. They are exclusively of Swedish make, and several of the most important works have taken up the manufacture on a large scale, not only for the home market, but for export. In consequence of its simple construction and the readines with which it is understood, the two-cycle type has been very favorably received in agricultural and small industrial circles.

The British Consul-General at Frankfort thinks that last year was a period of resuscitation for the electrical industry in Germany, after its term of depression. The field of application of the electro-technical industry has been largely extended and offers the best prospects for the future, as electrical power is constantly being introduced in directions in which it has hitherto been unknown. Thus, in the mining industry it is becoming ever more popular for driving the heavy machinery used for ventilating the mines, for hoisting raw material, and in numerous other ways. The perfecting of steam turbines during recent years assisted the extended use of electricity, as did also the more general manufacture of tools and tool machinery driven by electric power. The Düsseldorf Horticultural Exposition afforded a certain section of the German machine industry an opportunity of exhibiting some of their latest achievements in the halls of the exhibition of the previous year, and it is said that in contrast with the lack of system in the machine department of the St. Louis Exposition, the small but well arranged electric power station at Düsseldorf appeared a model installation, gaining particular interest from the fact that for the first time a steam turbine of German invention and built in Germany was there exhibited. This horizontal steam turbine, built at Berlin, had two fly-wheels of 1,200 millimeters diameter; between the two wheels, and on the same shaft, the continuous current generator of 100 kilowatts capacity was mounted. The high-speed turbine was worked with quadruple expansion, the steam pressure dropping in its transit through the four steam chambers from 10 to 2 to 0.5 to 0 atmospheres. The construction was exceedingly compact, the total weight of the turbine, completely set up, including the trestle for the bearing, amounted to only 8.2 tons. In order to clearly demonstrate the steady motion of the turbine it had been mounted on the top of a light iron trestle, and the condenser, the pump of which was driven by a special motor, was affixed underneath. It is maintained by some authorities that the relatively small installation at the Düsseldorf Exposition satisfied experts much more than the great display at St. Louis, because it was so entirely up to date. The Germans never miss a chance of advertising their latest achievements.

London. F. C. C.

An article in *Dingler's Polytechniches Journal* discusses the possible use of steam turbines for driving locomotives. The prospect of employing in this service such turbines as we have to-day does not seem promising for several reasons. One is the very high vacuum required for the economical working of a turbine, making the condensing apparatus a very important part of the equipment. Another obstacle is the difficulty of reversing and the elaborate construction required to make reversing possible; another the high angular velocity of the turbine, making necessary a geared transmission, as in automobiles.

It would look as if the most feasible way of applying the turbine to this service would be by direct-connecting it to an electric generator and rotating the driving-wheels of the locomotive by electric motors, as was done in the Heilmann locomotive—which had its generator driven by a reciprocating engine. We should still have the condensing outfit to lug along, however, if any great degree of economy were to be obtained.

A despatch from Utica, N. Y., to a daily paper describes the following accident: George Butler, while assisting the machinist in the United States Condensed Milk factory, at Deansboro, was caught in the shafting and his body was whirled around at high speed for a minute before he was released. All his clothing was torn from his body, and that he was not killed is due to the circumstance that the clothing gave way. During the thrilling experience he retained consciousness. Though severely bruised, it is not thought that he suffered any injuries from which he will not soon recover. It is estimated that Butler was whirled around the shafting 450 times.

Violet-colored bronze is 50 parts copper and 50 parts antimony.

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Contents.

	PAGE
The Differential Band Brake	691
The Electrical Equipment of the D., L. & W. R. R. Shops at Keyser Valley, Pa	692
Echoes From the Oil Country—Another Reason for Hard Castings.	693
Two Home-Made Traveling Cranes	695
Skin-Drying Foundry Molds With City Gas	699
Felling a Large Chimney	700
The Largest Passenger Steamship	700
Bench-Lathe Attachments	701
Letters to the Editor	703-708
Some Features of a Large Blowing Engine	708
Motors for Various Sizes of Machine Tools	710
Professor Sweet's Artisan School	714
Foreign Markets for American Machinery	715
Mr. Carnegie on Public Utilities	716
A New Kind of Strike	716
A Suit to Make Employment Permanent	716
Our Consuls and Their Value	716
The Coming A. S. M. E. Meeting	717
New Tools and Machine Shop Appliances	717
The "Universal" System of Machine Molding	718
Robert Whitehead and His Torpedo	721
Personal	722
Obituary	722

Mr. Carnegie on Public Utilities.

Most men who have attained the age and the millions possessed by Andrew Carnegie are convinced that the world is just about perfect; that no improvement can be made in it. Not so with Andy, however; he preserves the youthfulness of his mind, apparently, and on his recent return from Europe he granted an interview to reporters, in which he gave what must have been rather a severe shock to some of his admirers who are opposing, as best they may, any progress toward public ownership or control of public utilities. Mr. Carnegie has lived in Europe enough to be familiar with such public control of what by right belongs to the public, and he has no hesitation in saying that he favors it. He of course knows that there will be difficulties to be overcome, but he believes that these difficulties can be overcome; that we have the men who can overcome them, and that we must learn how to do it. They have learned how to do it abroad, and, naturally, Mr. Carnegie sees no reason why the same thing cannot be learned here.

Of course, it will not do to call Mr. Carnegie any of the names that some of our contemporaries are in the habit of calling those who dare to say that the public may properly own or control its own public utilities; such names do not fit Mr. Carnegie, and, therefore, those who have been so freely using them are now generally pursuing a course of masterful silence and ignoring so far as possible what Mr. Carnegie has said upon the subject.

Meantime it is becoming better and better understood among those who, like Mr. Carnegie, endeavor to keep open minds, that the principle of "mine, thine and ours" is the true one, *i. e.*, that which can be freely carried on by private individuals or corporations without infringing the rights of the public should be so carried on, while all those functions of a public nature requiring public franchises and special privileges and in which there can be no such thing as free and open competition, are best retained within the control of the public.

A New Kind of Strike.

A very peculiar strike has taken place upon the railways of Austria. The employees becoming dissatisfied concluded to organize a strike upon the plan of what is called "passive resistance." That is to say, the men are on duty as usual and are working right along, but instead of running trains they are merely observing rules; and the strict observance of the rules which have been laid down by the administrators of the railroads makes it practically impossible to operate the road. This attitude of the men makes it difficult to criticize them. They are merely observing strictly the rules laid down for their guidance, or supposed to be for their guidance, by their superior officers—and it is difficult to find fault with men who do that.

The outcome is rather ludicrous, however, and serves to illustrate in a forceable way the fact that on Austrian railroads, trains are gotten to their destinations largely by ignoring rules. The same thing is true of American roads; they are loaded with rules known to be regularly ignored, but which, however, are promptly appealed to in case of an accident or a damage suit.

A Suit to Make Employment Permanent.

Regarding our article published at page 650, in which we discussed a lawsuit between the Meek Company, of Coshocton, Ohio, and a salesman who had left them, it will be remembered that our discussion was based upon the assumption (which seemed to be indicated by the news item) that there was no contract between the company and the salesman, and that the suit was simply to determine whether a man would have a right to render service to a new employer, the value of which service is based upon experience and skill developed while in the service of the antecedent employer.

We are now informed by the Meek Company that there was a contract, which it claims was broken, and that the gist of the suit is to determine whether an employer has a right under such contract or not.

Needless to say, we believe in the full and complete carrying out of contracts, both by manufacturing concerns and by their employees. However, the question of whether an ex-employee has the right to use in the employ of another company experience gained previously, has been disputed and there have been employers who have contended that such a right does not exist; a belief in which, needless to say, we do not concur.

Our Consuls and Their Value.

In *Dun's Review* of October 28, a writer who is identified only as "an ex-consul now at Washington," has an article entitled "Improvements in the American Consular Service," in which he says: "A writer in the *Atlantic Monthly* some years ago took consuls to task because he believed their reports were without value. To prove his point he said that Mr. Miller, editor of the AMERICAN MACHINIST, had sent to his paper, from abroad, better reports than any consul could possibly prepare. As a matter of fact, Mr. Miller based his reports, at least all that was best in them, on information obtained from United States consuls at Berlin, Chemnitz and other European cities. Nobody knows more about the value of United States consular reports than does Mr. Miller and his colleagues on the AMERICAN MACHINIST."

There may, of course, be a difference of opinion as to what is best of that which is contained in the reports referred to, but Mr. Miller, while abroad on the tour of investigation which resulted in the publication of his articles, met the consuls at Liverpool, Berlin and Moscow only, and though these were very courteous and helpful, he himself considers that by far the best portions of the articles referred to were based upon information gained in the commercial houses in which machinery is sold, the machine shops, and from the proprietors of, and workmen in, machine shops in Europe.

The Coming A. S. M. E. Meeting.

It will be noted by the outline program of the coming meeting of the American Society of Mechanical Engineers in New York, which we printed last week, that the Committee on Meetings has contrived to arrange for doing some new things, and things which are likely to prove not only interesting but, by stimulating interest, induce a large attendance and thus again and in another way add to the pleasure and profit of all who may attend the meeting.

The business session to be held on board the new steamship "Amerika" will of course be interesting; it will be the first meeting of the society on German territory, and there will be an unusual opportunity for examination of what is, in many respects, the most remarkable vessel now afloat.

The place of meeting for the other sessions (Edison Building, 44 West Twenty-seventh street) will afford ample room for all who come, and the unpleasant crowding resulting from the attempt to compress a meeting into the society's house will be avoided. Professor Wood's lecture is likely to prove of exceptional interest, and altogether it is likely to be seen before the meeting is over that the society owes much to its present meetings committee.

The new Union Station at Washington, D. C., for the Baltimore & Ohio and Pennsylvania railroads is to have a central power plant, which, though important in its functions, has been somewhat cramped in the ground-space assigned to it. This furnishes a condition which one of the advantages of the steam turbine admirably meets, and partly on this account they are to be used. An order has been placed for four Westinghouse 500-kilowatt turbo-generators, to use dry saturated steam at 150 pounds pressure, with a vacuum of 25 inches, the speed being 3,600 revolutions per miute. The generators will be of the rotating-field type, with two poles, delivering three-phase alternating current at 2,300 volts and a frequency of 7,200 alternations per minute. They will operate practically noiselessly, as they will be of the enclosed type.

New Tools and Machine Shop Appliances.

THE HOEFER ADJUSTABLE PIPE-THREADING MACHINE.

The Hoefer pipe-threading machine contains the following features: The dies are fed forward and are withdrawn automatically, cutting the pipe to a standard taper and leaving the thread cut clean and perfect. By a slight and quick adjustment the thread can be cut either over or under the standard size. The machine is

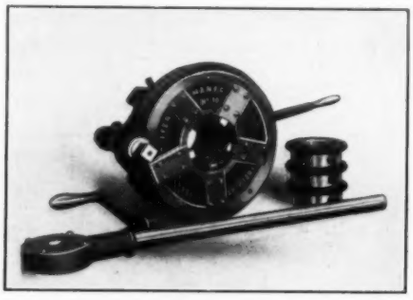


FIG. 1. THE HOEFER ADJUSTABLE PIPE-THREADING MACHINE.

made in two sizes, and each machine has one set of five dies, which is all that is necessary to cut threads on all sizes of pipe within its range—the smaller size machine cutting from 2½- to 4-inch pipe, and the larger from 4½- to 6-inch. The dies are readily sharpened by simply grinding the face, and except for sharpening are never taken out of the machine, so the loss of time changing dies is avoided, also the risk of losing the dies themselves.

The general appearance of the machine is shown in the half-tone, Fig. 1, and the details of construction by the line drawings, Figs. 2 to 8.

Fig. 2 is a section on the line 2—2 of Fig. 3, which latter is a face or front-end elevation of the machine; Fig. 4 is a section on line 4—4 of Fig. 2; Fig. 5 section on line 5—5 of Fig. 2; Fig. 6 is one of the threading dies; Fig. 7 is a partial section showing the wrench (Fig. 8) in position for rotating the cam-disk to adjust the dies radially preparatory to cutting threads on pipes of different diameter.

Like letters of reference indicate corresponding parts throughout the several views.

A is the pipe to be threaded, which is held firmly clamped in a steam-fitter's vise, not shown in the illustration.

B is the frame of the machine. It has a central hub B^1, internally threaded, the thread being of the same pitch as the dies. Into another portion of the frame is inserted a bushing B^3, the bore of which corresponds to the size of pipe to be threaded. The machine is clamped to the pipe by set-screws B^5.

C is the die-head with radial recesses for the dies *E*. Its hub C^2 is externally threaded and screws into the hub B^1 of the machine frame. The outside of the die-head *C* is formed as a spur gear. When the die-head is rotated the screw thread on its hub draws it along, so that the operator does not have to force the dies forward on to the work.

Back of the die-head is another disk, also having gear teeth on the outside. This disk is marked *D*, and is mounted on the hub of the die-head. It has on its face a spiral cam-groove, clearly shown in Fig. 5. The cam-disk is retained in its

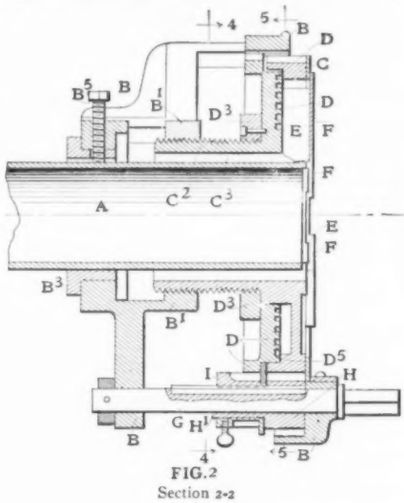


FIG. 2
Section 2-2

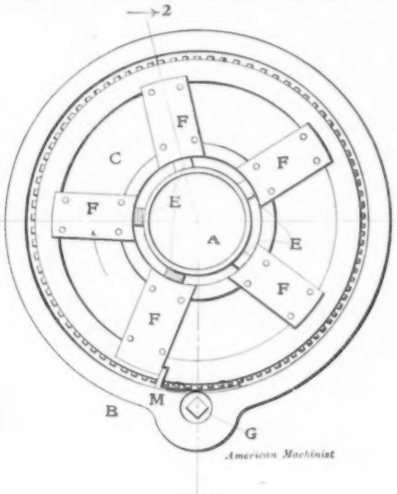


FIG. 3
Front Elevation

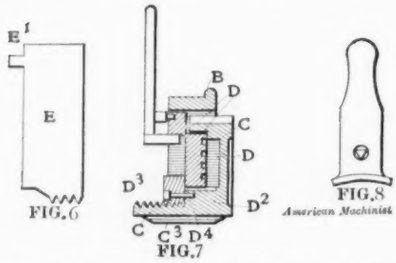
THE HOEFER ADJUSTABLE PIPE-THREADING MACHINE.

place on the hub of the die-head by the ring D^3 (Fig. 2), which is screwed onto the hub C^2 and secured by a small screw.

The threading dies *E* each have an actuating lug *E*-1 (see Fig. 6) which projects into the spiral groove in the cam-disk *D*.

The dies are retained in the radial recesses in the die-head by cover-plates *F*. Thus they are able to slide in and out radially under the control of the cam-disk.

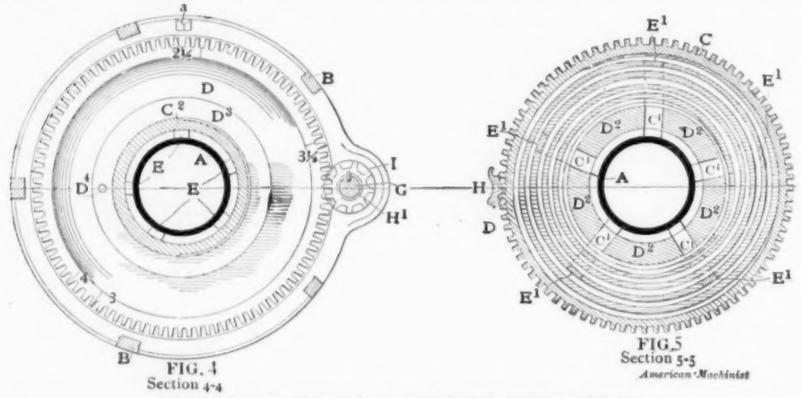
G is the driving shaft, having a squared end for the handle or lever by which the machine is operated. This shaft carries a pinion *H*, which it drives through a spline and which meshes with and drives the die head *C*. The pinion has on one side a projecting sleeve *H*-1, upon which is mounted, and to which is splined another pinion *I*, which normally meshes with and drives the cam-disk *D*, but which, by loosening the small set-screw, may be slid along the sleeve and disengaged from the cam-disk, so that the latter may be rotated to radially adjust the dies to any particular diameter of pipe to be threaded. This is done by the wrench shown in Figs. 7 and 8, the projecting stud of which is inserted between any two teeth of the cam-disk *D*.



THE HOEFER ADJUSTABLE PIPE-THREADING MACHINE.

The pitch of the teeth on the cam-disk and pinion is such that, as the shaft *G* is turned to rotate the die-head and the cam-disk, the latter will be rotated slightly faster than the former, with the result that the dies *E* will recede toward the periphery of their head *C* simultaneously with their operation of cutting the thread on a pipe, thus continuously enlarging the circle circumscribed by the cutting ends and resulting in the formation of a tapered thread on the pipe.

The cam-disk is marked with figures denoting the different sizes of pipe, and the adjustment is facilitated by these, the disk being turned by the wrench so that the pointer *a*, Fig. 4, is opposite the figure corresponding to the size of pipe to be threaded. This having been done, the pinion *I* is slid back into mesh with the cam-disk and secured by the set-screw, and the wrench (Fig. 8) is removed; the machine is then ready to commence cutting. After a thread of the requisite length has been cut, the die-head is rotated in the opposite direction until the dies disengage from the thread on the pipe, when the set-screws *B*-5 may be loosened and the machine removed from the pipe.

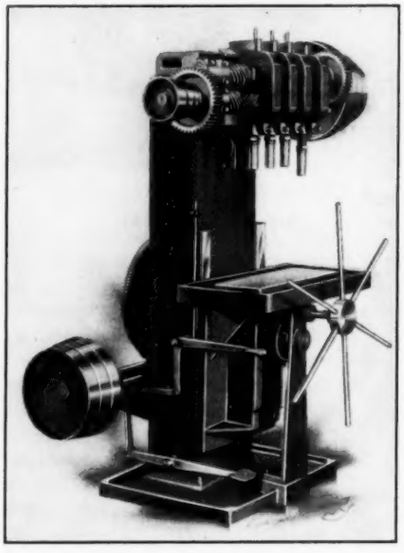


THE HOEFER ADJUSTABLE PIPE-THREADING MACHINE.

This machine is constructed by the Hoefer Manufacturing Company, Freeport, Ill.

GANG DRILL.

The half-tone shows a heavy type of gang drill recently built by the Moline Tool Company, of Moline, Ill., and having their well-known spiral drive for the spindles. It will be noticed that a double system of spiral driving gears is arranged in the rail, the first spindle being driven by the lower spiral, the second by the upper, and so on. The spindles are vertically adjustable and run in bronze bushings. The machine will drill holes up to ¾ inch and, with this size drill, within 2¼ inches of each other. The tool is powerfully geared, the feed being back-geared 4 to 1. The table is counterbalanced and provided with automatic stop and quick return.



GANG DRILL.

The "Universal" System of Machine Molding—I.

We illustrate herewith some of the apparatus for molding by machinery according to the methods pursued in the system of MM. Ph. Bonvillain and E. Ronceray, of Paris, which was first developed in France on the Western Railway by MM. Saillot and Vignerot, and was then taken up by the firm of engineers mentioned and thoroughly improved, and new patents obtained covering the apparatus employed.

THE MOLDING MACHINE.

The molding machines used are operated by hydraulic pressure because of the positive steady motion, free from shock or abrupt starting and stopping, and the speed of which is subject to very close control, and the pressure used in each case can be exactly determined by means of a pressure gauge on the machine.

Fig. 1 shows machine of size A-3 in the act of ramming; Fig. 2 a smaller machine, A-4, empty, but with the swinging head-piece and hook in position; and a still smaller size, A 5, is shown in Fig. 3, the crossbeam being swung open, giving free access to the machine on three sides, the mold being shown in the operation of drawing the pattern.

The molding machine in general consists of a box base or hollow pedestal, the top of which forms a table upon which the pattern plate is fixed. A movable head-piece pivoted on the back column carries the hydraulic cylinder for ramming the sand. To the outer end of the head-piece is pivoted a rod having a hook on its lower end, which holds the head-piece in the right position for ramming. The hollow pedestal contains a vertical hydrostatic press, the ram of which supports a movable table with four brackets holding four vertical rods working outside the body of the machine and engaging the four projecting corners of the stripping plate, when one is used, and thus performing the function of lifting the flask and mold up off the pattern. In some special cases, where long cores, gears, etc., have to be dealt with, they make use of a machine with a double pressing device, which insures an equal pressure being exerted over the whole length of the core, or gives an additional ramming in the weak parts of the mold. The movable head-piece has the advantage of leaving the access to the flask entirely free for the operator to move around for ramming the sand by hand in the difficult corners if necessary, and avoids any interference with the lifting of the flask.

The following is the procedure followed in using the machine: The movable head is swung out of the way to give free access to the pattern plate, the flask is placed in position on the table and filled with sand. A swinging sand distributor is made for use with some of the machines, which enables this to be done very rapidly without any shoveling at all, and which

insures that the correct amount of sand is put in the mold at once after the capacity of the distributor has once been properly adjusted to the job in hand.

The large volume of the sand before ramming is taken care of by a loose flask which is placed above the regular flask. If necessary, the sand is roughly rammed by hand, and then the head-piece is pulled into position and secured by the hook. The power is now applied to the top ram by pulling over the small hand lever, which is released as soon as the sand is rammed; this can easily be determined by the small pressure gauge on the head of the machine. The hook is then released and the head again swung clear of the work.

To lift the mold off the pattern a second hand lever is moved, admitting pressure

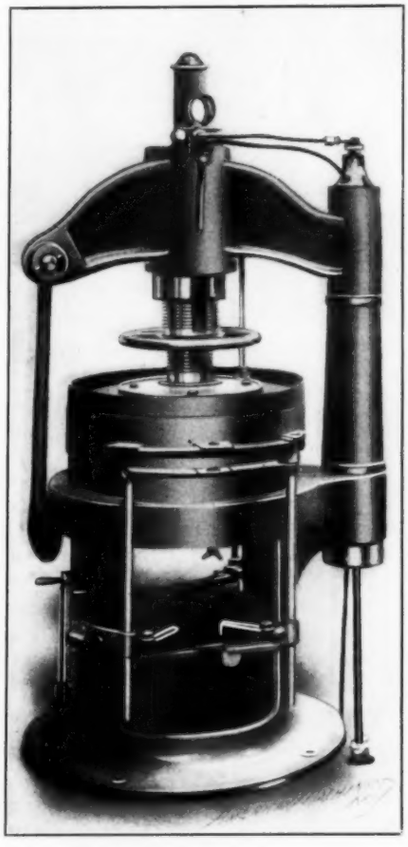


FIG. 1. THE BONVILLAIN MOLDING MACHINE.

into the lower cylinder, raising the ram, the stripping plate, flask and mold.

The details of the construction of this machine will be a little more evident from the line drawings, Figs. 5, 6 and 7, showing sectional plan, vertical section and side elevation, respectively; these were taken from the *Revue Industrielle*. *a* is the hollow base or frame of the machine; *b* is the table at its upper portion; *c* are crossbars resting on a shoulder formed in the inner edge of the table; *d* is the lug supporting the vertical column *d'*, around which swings the head-piece *e*, having a hook suspended from its other end. The bars *c* support the bed or pattern plate *r*, upon which are fixed the patterns *s*; *t* is the flask having lugs *t*.

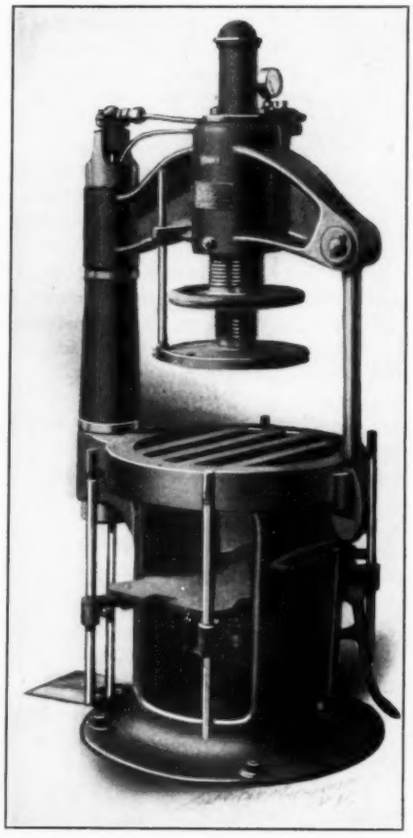


FIG. 2. THE BONVILLAIN MOLDING MACHINE.

Two cylinders in tandem are cast with the head-piece *e*. The plungers are prevented from turning by the screw *n* engaging in a vertical groove in the side of the lower plunger. This plunger has a right-hand thread formed within it, into which is screwed a long sleeve, or socket *o*, having a hand-wheel at its lower end. This socket, in turn, has a left-hand thread inside of it, and into this is screwed the

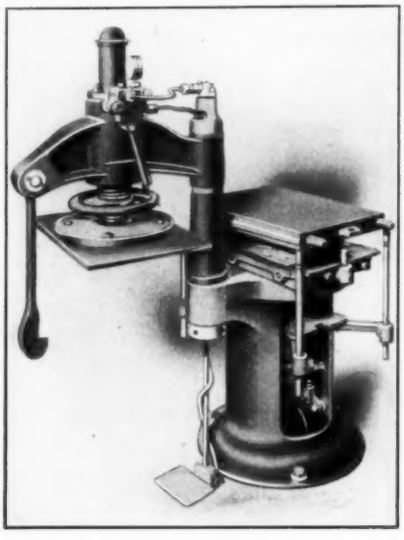


FIG. 3. THE BONVILLAIN MOLDING MACHINE.

sleeve or cylindrical shank of the ramming plate *p*. The latter is prevented from rotating by the rod *q*, which slides in a lug on the head-piece.

The upper and smaller cylinder *l* is constantly under pressure on the lower side of its piston, so that its tendency is to keep the ramming plate up or to bring it up when it is not forced down by the pressure above the larger piston in cylinder *m*. Waste of water and of time from an unnecessarily long stroke is prevented by adjusting the height of the ramming plate when at the top of its stroke by turning the hand-wheel. When this is

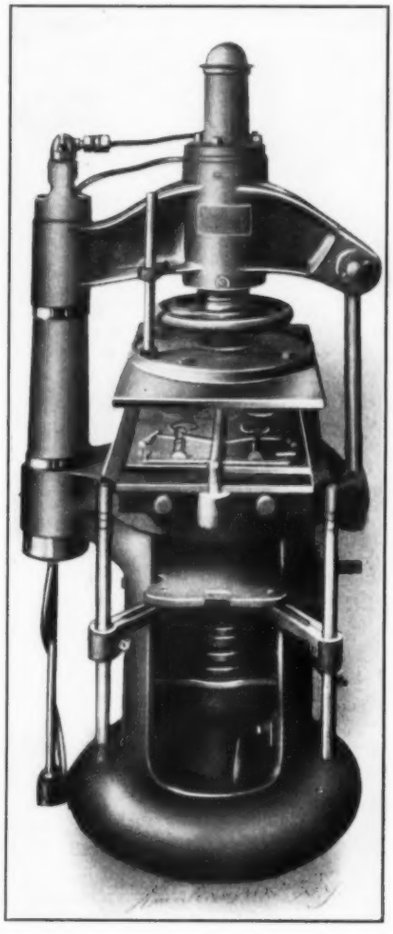


FIG. 4. THE BONVILLAIN MOLDING MACHINE.

once fixed for a given height of pattern plate and flask, it is, of course, not necessary to alter it on that job.

f is the lower hydraulic cylinder, supported on the horizontal part *a'* of the frame of the machine. The plate *g* is supported on the piston of this cylinder, and has portions projecting through the openings in the side of the frame of the machine, as may be seen in the plan. The part which forms the connection between the piston and the plate *g* is threaded and carries a nut *f'*, which, in turn, is externally threaded and carries another nut *f''*.

h is a segmental collor pivoted at *h'* to the plate *a'* of the machine frame, and

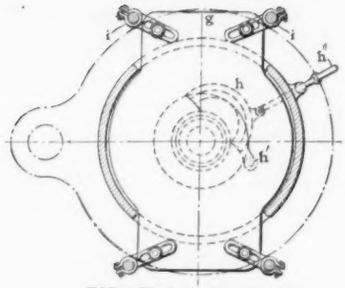


FIG. 5 Horizontal Section A-A

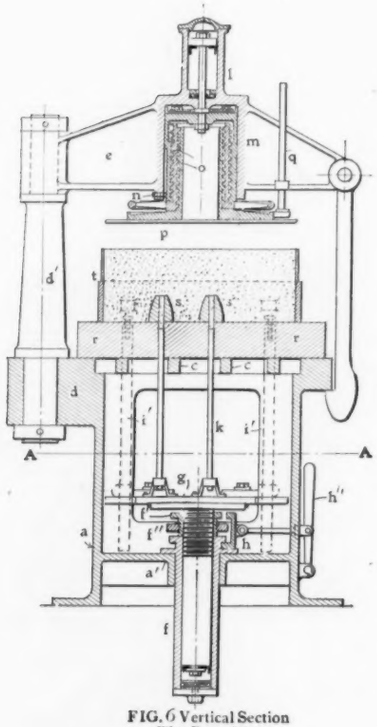


FIG. 6 Vertical Section
The Bonvillian
Molding Machine

is brought by the lever *h''* into engagement with the rings of the piston *f*, thus limiting the vertical motion of the latter.

i are clamps holding the rods *i'*, which can be so adjusted as to come opposite the lugs or ears *t'* of the flask.

The stools and stripping-plate supports are also fixed to the sliding plate *g*.

After the mold has been compressed by the action of the large cylinder *m*, the sliding plate *g* is elevated by the action of the cylinder *f*, the effect being to compress the green sand cores by the motion of the rods *k*. The motion comes to a stop at the time the ring *f''* touches the upper flange of the collar *h*, the nut *f''* having been properly adjusted; at the same instant the rods *i'* just touch the lugs *t* on the flask, through the adjustable screws at their upper ends.

The pattern is then drawn as follows: First the ram of cylinder *f* is let run back; then the collar *h* is drawn out so that it no longer restrains the motion of the ram; then the ram is raised again, raising plate *g*; by means of the rods *i'* raising the flask and mold, while the cores are pushed up by the stools *k*. By the time the ram is all the way up the mold is entirely free from the pattern.

Where necessary to keep the mold from breaking, stripping plates are used, and if so desired these may be made to press up on the sand during the first motion of the lower plunger, before that in which the pattern is drawn.

THE ASSEMBLING MACHINE.

Flasks as ordinarily made are square or rectangular; it will be noticed, however,

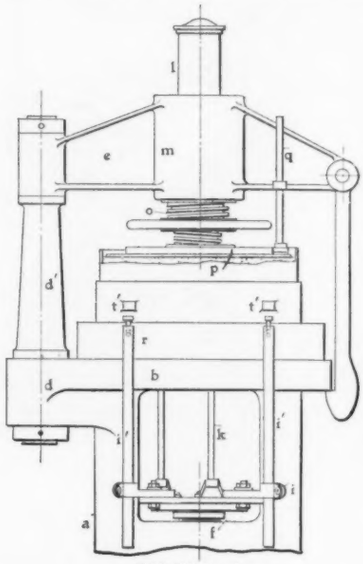


FIG. 7 Elevation
American Machinist

in these illustrations that round flasks are employed in the Bonvillain system. This they do wherever possible, and especially where green sand is used. The reasons for the use of round flasks will appear in what follows.

The application of machinery to the preparation of the mold does not end with the drawing of the pattern, for the molding machine is supplemented by another machine which they call "La machine à assembler et à demotter," which may be translated as "the assembling and forcing-out machine," the function of which consists of assembling with rapidity and accuracy the two parts of the mold, and then forcing the sand mold out of the flasks, which become available for another mold. This operation is analogous to snap flask molding, but is considered to be superior to it in several ways. Thus, the round flasks, made in a single piece, have proved to be substantial where the snap flasks are fragile; they have a precision which is lacking in the snap flasks on account of their numerous hinges and joints.

The assembling by machine permits of

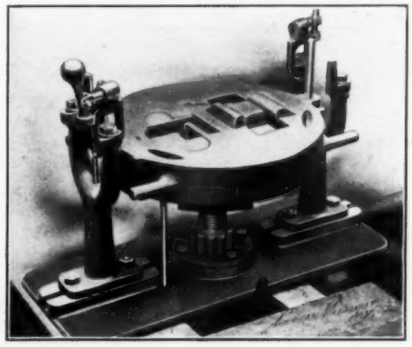


FIG. 8. THE ASSEMBLING MACHINE.

closing rapidly and exactly molds for pieces which are high and narrow, without hesitation or loss of time.

The round form of the mold is more favorable to the insertion of hoops, which are sometimes inserted in the mold to sustain the pressure of the liquid metal, when the pieces are near the edge. However, sometimes square or rectangular flasks are used, as may be seen in Figs. 3 and 4.

One assembling machine will generally take care of the product of two molding

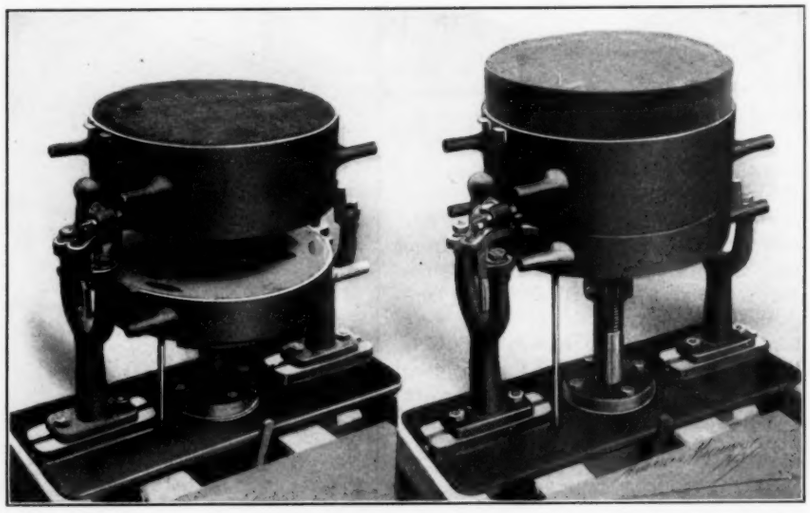


FIG. 9. THE ASSEMBLING MACHINE. FIG. 10.

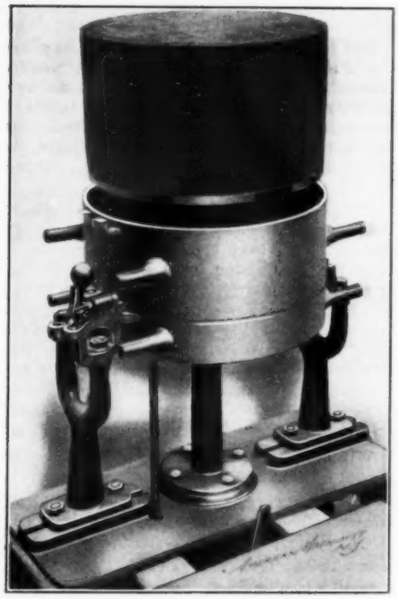


FIG. 11. THE ASSEMBLING MACHINE.

machines, and a plant composed of two molding machines and one assembling machine may be operated by two, three or four men, according to the kind of work to be done, the conditions of installation, and the output desired.

The assembling machine is shown in Figs. 8 to 13. It is formed with a foundation plate, below which, in the center, is a hydrostatic cylinder, the ram of which extends vertically upward and supports the table. The foundation plate is provided with T-slots, to which are clamped two columns formed with forks at their upper ends, and so adjusted that the distance between them will correspond to the size of the flasks used.

Between the two branches of the forks and on internal projections are fixed two vertical rods, provided to engage the stud-holes of the flask. Parallel to these, and right in the center of the forks, are two other similar movable vertical rods, connected at their lower ends with balance-weights, heavier than an empty flask, but lighter than one filled with sand. The ends of the forks are provided with locking devices. A stop is provided to prevent the ram of the hydrostatic press from lifting too far.

FIG. 12. THE ASSEMBLING MACHINE.

The operation of the assembling machine is as follows: The table is brought up above the middle of its travel, and a sheet-iron plate a little smaller than the inside of the flask is placed on it. The nowel is then placed on this, as shown in Fig. 8, the guiding holes engaging with the vertical rods, and the ears of the flask clearing the branches of the forked supports. The table is then allowed to descend, the nowel going down with it and lifting the balance-weights, which are lighter than the flask full of sand. The parting surface of the nowel is of course up. The cope is then brought and placed on the machine, parting surface down, the ears of this part of the flask resting on the projecting forks and causing the cope

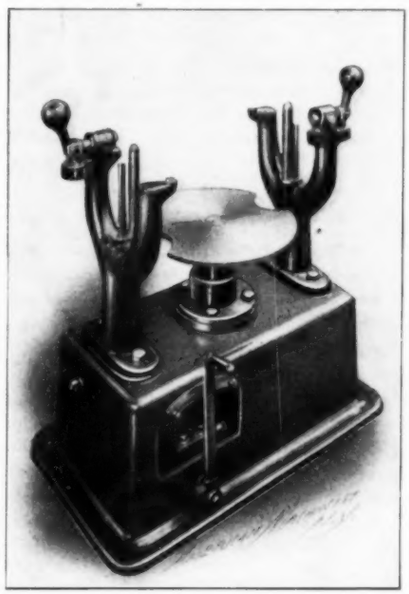


FIG. 13. THE ASSEMBLING MACHINE.

to rest there, being perfectly level, as is the nowel, and being in accurate register with it by reason of the vertical rods entering the guiding holes. This step in the operation is indicated in Fig. 9. The cope is locked in place, and the water pressure is then put on, raising the ram, the table and the nowel, the two parts of the mold coming together with precision. The top flask being locked in place, the lower one can move up no farther, so if the water pressure be still maintained in the cylinder, the sheet-iron plate goes through the flask, carrying up the sand mold and forcing it out of the flask, as seen in Fig. 10. Fig. 11 shows the mold completely forced out of the flask, ready to be lifted on to the floor by means of the plate, which had at the start been placed on the table of the machine.

The locks are then thrown back and the upper flask lifted off. The lower one, which has since the expulsion of the sand been kept up by the counterweights (see Fig. 12), is then likewise removed, and the flasks and machine are ready for another mold. This operation does not take as long to perform as might be supposed from the length of the explanation, but is executed very rapidly. It should be mentioned that dry-sand cores, when needed, are readily inserted before closing up the mold.

If it should be desired to keep the mold in the flask during the pouring, it is only necessary to dispense with the use of the locks, and the mold can be lifted off in the flask after the two parts have been brought together.

Robert Whitehead and His Torpedo.

The following account of the Whitehead torpedo and its inventor, whose death recently occurred in England, forms a portion of a very interesting editorial article appearing in the New York *Evening Post* of November 15:

The death in England yesterday of Robert Whitehead, the inventor of the automobile torpedo, ends the career of a man who as fairly revolutionized naval warfare as did Ericsson with his monitor. Not that Whitehead first hit upon the idea of blowing up vessels by torpedoes. For more than a century prior to Whitehead's success, there had been recourse to stationary or movable torpedoes. During our Civil War they became a large factor, the Confederates destroying with them seven Federal ironclads, thirteen wooden war vessels, and seven transports, besides damaging eight other ships more or less severely. These feats were accomplished, either by anchoring torpedoes in the channel, as at Mobile, where the Tecumseh was sunk, or by exploding them alongside a vessel from a small boat. This involved great risks, and not infrequently cost the lives of all the assailants, as happened in some of the attacks on the Union fleet off Charleston. When Cushing sank the Confederate ram Albemarle he did so with a little launch carrying a torpedo fixed to the end of a spar.

To supplant this clumsy method, so unfavorable to the attacking forces, by a dirigible torpedo became more than ever the objective of naval inventions, as soon as the civil war demonstrated what havoc could be wrought by an underwater explosion. A Capt. Lupuis, of the Austrian navy, had by 1864 progressed far enough with his plan of an automobile torpedo to need the assistance of a good working mechanic. He engaged Mr. Whitehead, then manager of an engine manufacturing company at Fiume. From that time on, Mr. Whitehead devoted himself to the automobile torpedo. Abandoning Capt.

Lupuis' plans, he succeeded, in 1867, in perfecting the delicate machine which bears his name, with only the assistance of his son, a mere boy, and one trusted workman. As a result of that success, every navy has its fleet of torpedo boats and torpedo-boat destroyers, and almost every cruiser and battleship has its torpedo-launching tubes. In order to combat this terrible weapon, there was introduced first the torpedo netting, now discarded, and then the quick-firing guns, intended to protect a warship by an incessant hail of projectiles. Incidentally, the weight of armor on all protected vessels was greatly increased, and finally the submarine was undoubtedly hastened by the Whitehead invention. Indeed, the torpedo has probably had a greater influence than any other factor, save the comfort of men and officers, in developing the modern top-heavy, high-sided fighting vessel, as the standard type of battleship, instead of the Ericsson monitor.

Whitehead's first torpedo was of steel, 14 inches in diameter, weighing 300 pounds, and carrying as its explosive 18 pounds of dynamite. Its speed was low —only six knots—and the right to manufacture was purchased by the English government in 1871 for the trifling sum of $15,000. As now developed, the Whitehead, whose motive power is compressed air, has attained a speed of 26 knots an hour, with a range of 4,000 yards. It can be regulated to explode by impact or after a definite time; it may be set to travel at a uniform speed and depth the whole of its range, or both depth and speed may be varied. So remarkable is its mechanism that it may be made to rise to the surface or sink to the bottom after missing its mark. Its "war head" being detachable, it can be used again and again during practice with perfect safety. In length, the Whiteheads used by the United States navy vary from 13 to 18 feet. Whitehead himself redesigned his torpedo in 1876, 1884 and 1889. By 1885 and 1886 torpedo-boats for the discharge of these weapons were constructed by Austria, Chile, China, France, Greece, Italy, Portugal, Russia, Spain, Sweden, Turkey, Germany and Great Britain. Today, England alone has 142 torpedo-boat destroyers, 117 first-class torpedo-boats and 72 of second class, in addition to 39 submarines built or building. In addition to this, automobile torpedoes are part of the coast defense of several nations.

It is announced that the Cadillac Motor Car Company and the Leland Faulconer Manufacturing Company, of Detroit, have been consolidated. The latter company has for some time been occupied almost if not quite exclusively with manufacturing for the former, and we suppose will now be known only as a motor-car building establishment.

What was the Milwaukee branch of the American Society of Mechanical Engineers has been converted into a local engineering society, which is independent of the national society referred to. Our information is to the effect that the outlook for the new society is good, and that it seems to have a bright future before it.

Personal.

John Cassan Wait, M.C.E., LL.B., will deliver the address on the occasion of the celebration of Founder's Day at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y.

Obituary.

Michael Hueston, for forty years an engineer in the employ of the New York & Brooklyn Ferry Company, died recently at Greenpoint, L. I. He was one of the oldest employees of the ferry company.

Robert Whitehead, inventor of the torpedo which bears his name, died November 14 at Shrivenham, Berkshire, England. The idea of the self-propelling torpedo is said to have originated with an officer of the Austrian Marine Artillery, but the first practical trials of the torpedo were made in 1864 by Whitehead, who was the superintendent of the iron works at Fiume. Since that time the Whitehead torpedo has undergone many improvements.

Frederick Henry Betts, a prominent authority on patent law and counsel in many famous patent cases in which important interests and large companies were involved, died at his home in New York on November 10. He was born in Newburg in 1843, was graduated from Yale and was admitted to the bar from Columbia Law School. He was prominent in the public affairs of his city and State, and was for several years Lecturer on Patent Law at Yale University, where he founded the Betts prize in the Law School.

Albert J. Pitkin, president of the American Locomotive Company, died November 16 of nervous prostration at his home in New York city. He was born in Northampton, Ohio, in 1854. At seventeen his father apprenticed him for three years to the Webster, Camp & Lane Machine Company, of Akron. One year after his indenture had been served, he entered the locomotive repair shops of the Cleveland, Akron & Columbus Railroad at Akron and became an expert machinist. He was five years in the Baldwin Locomotive Works at Philadelphia, and then became successively mechanical engineer of the Rhode Island Locomotive Works, superintendent of the Schenectady Locomotive Works and vice-president and general manager of the latter. When the American Locomotive Company was formed, he became first vice-president, and after the death of President S. R. Callaway succeeded him to that office.

Business Items.

The haulage locomotives used for handling construction trains, etc., in the great Simplon tunnel, now nearing completion, are operated by compressed air furnished by two Ingersoll-Sergeant air compressors. Both of these machines are belt-driven from water-wheels, and are of the type known to the makers as "Class BC-3."

Owing to the steady increase of the electric crane business, Pawling & Harnischfeger, Milwaukee, Wis., have found it necessary to extend the girder and erecting shops of their new works, making these departments nearly 300 feet long. The order for thirty-four electric cranes for the extensions to Allis-Chalmers Company's West Allis works has been awarded to Pawling & Harnischfeger.

Manufacturers.

William Sancto is erecting a large pattern shop in Franklin, Pa.

The Ajax Forge Company, Chicago, Ill., will construct a new plant.

The Columbia Box Factory, St. Louis, Mo., was burned; loss, $175,000.

The North Georgia Fertilizer Company is erecting a plant in Rome, Ga.

The St. Louis (Mo.) Car Company will erect shops at Parnassus, Pa.

The Delhi (N. Y.) Ornamental Iron Works will move to Middletown, N. Y.

The Pratt & Whitney Company, Hartford, Conn., will build a new foundry.

The Carroll Barb Wire Fence Company, Peoria, Ill., will erect a new plant.

The Nathaniel Turfts Meter Company, Boston, Mass., will erect a new building.

The Richards Company, Aurora, Ind., hardware specialties, will double its plant.

The Conklin Boiler Works, Thief River Falls, Minn., is erecting a new foundry.

The Dominion Coal Company, Ltd., is erecting a new foundry at Glace Bay, N. S.

The Standard Foundry Company, Hartford, Conn., will build an additon to its plant.

The Fostoria (O.) Motor Car Company is being formed with a capital of $300,000.

The American Spiral Pipe Works, Chicago, Ill., will erect a $150,000 plant at Cicero.

The automobile plant of Apperson Bros., Kolsomo, Ind., was burned; loss, $40,000.

The Dixon Car Wheel Company, Houston, Tex., is replacing its foundry, recently burned.

The Western Machine Company's plant, at Albia, Iowa, was destroyed by fire; loss, $100,000.

The Meriden (Conn.) Brass & Iron Works is having plans drawn for an additional factory.

The Miles Steel & Tool Company, Middletown, O., will rebuild its plant on a larger scale.

The Carbondale (Pa.) Machine Company is rushing work on the construction of its new plant.

The Robbins-Myers Company, Springfield, O., is building an addition to its electrical shop.

The Lisk Manufacturing Company, Canandaigua, N. Y., will build a new annealing plant.

Wolf Bros. & Co., envelope manufacturers, Philadelphia, Pa., propose to erect a ten-story factory.

The Hetherington & Berner Company, iron works, Indianapolis, Ind., will erect a new factory.

The plant of the Pittsburg (Pa.) Wheelbarrow Company was destroyed by fire; loss, $20,000.

The Case Manufacturing Company, Columbus, O., is putting up an addition to its erecting shop.

The Canadian Rand Drill Company is contemplating a large addition to its Sherbrooke (Que.) plant.

The Indian Harbor and Cairo divisions of the Big Four Railroad will erect car shops in Danville, Ill.

The American Car & Foundry Company at Detroit, Mich., is building a large extension to its plant.

The Buffalo, Rochester & Pittsburg Railroad Company is building new shops at Lincoln Park, N. Y.

The foundry of A. C. Williams & Co., hardware manufacturers, Ravenna, Ohio, will be greatly enlarged.

The Coe Manufacturing Company, Painesville, O., maker of veneer machines, is to enlarge its foundry.

The city council of Fremont, Neb., has decided to buy a new set of boilers for the light and water plant.

The Indianapolis Southern Railway Company will build a new $10,000 roundhouse at Indianapolis, Ind.

The Allentown (Pa.) Manufacturing Company, making fertilizers and paints, has bought a new site.

The Whitelaw Wrecking Company, of San Francisco, Cal., will erect a large foundry in East Oakland, Cal.

The Seng Manufacturing Company, hardware specialties, Chicago, Ill., is building a three-story addition.

The Wildman Manufacturing Company, Norristown, Pa., builder of knitting machines, is erecting a new foundry.

Shops for the repair of wooden cars will be built and equipped by the Youngstown (O.) Car Manufacturing Company.

The Standard Machine Company, which makes bolt and nut machinery, will move from Norwalk, O., to Bowling Green.

The Smith Automobile Company, Topeka, Kan., is planning to expend $100,000 in enlarging the capacity of its plant.

The Whitney Manufacturing Company, Hartford, Conn., builder of machinery, will erect a new factory in Parkville.

The Duplex Printing Press Company, Battle Creek, Mich., has decided to erect another new building, at a cost of $50,000.

The Johnson & Field Manufacturing Company, Racine, Wis., making fanning mills, will build an addition, tripling its output.

The Superior Pin Company, Detroit, Mich., will erect a new plant, which, it is said, will be the largest of its kind in the world.

The Freeland Manufacturing Company, Niles, Mich., manufacturing tanks, tank heaters, etc., is planning to enlarge its plant.

The Consolidated Motor Car Company, of Utica, N. Y., has been formed. Francis P. Miller, president; H. H. Mundy, secretary.

The Sidney Shepard Company, metals and sheet metal goods, Buffalo, N. Y., will build a new factory and additions to the present one.

The plant of the Wenzelmann Manufacturing Company, Galesburg, Ill., hardware specialties, was destroyed by fire; loss, $15,000.

The Blackmer-Post Sewerpipe & Tiling Company, of St. Louis, Mo., will erect a branch factory in Texarkana, Tex., to cost $100,000.

The J. P. Rundle Manufacturing Company, Layton Park, Milwaukee, Wis., making plumbing fixtures, will erect four additions to its plant.

The S. Morgan Smith Company, York, Pa., manufacturing water-wheels, will put up a new shop, to be used for the erecting department.

The Chapman Valve Manufacturing Company, Indian Orchard, Mass., will put up two new buildings, one to be used for an iron foundry.

The American Woodworking Machine Company, of New York, will erect a new addition, to be used as a machine shop, at its plant in Aurora, Ill.

H. G. Lipscomb & Co., Nashville, Tenn., have secured a site for a factory for the manufacture of hardware specialties and for a warehouse.

The Erie Railroad will construct one of the largest ice-houses in the country at its new yards in Marion, O., which will be fitted with hoisting apparatus, etc.

The Old Dominion Bridge & Construction Company is being incorporated at Lynchburg, Va., with a capital of $300,000. Site for plant has been secured.

The D. J. June Machinery Company, of Waco, Texas, has been organized; capital, $30,000. Benjamin F. Lowery, George A. Clark, of Waco, incorporators.

The Concrete Construction Company has been incorporated at Houston, Tex., with a capital of $10,000. A plant for the manufacture of building blocks will be erected.

The Capitol Foundry Company, of Hartford, Conn., has been incorporated with a capital of $30,000. T. W. Stickle and Arthur A. Tanner, of Waterbury, are incorporators.

L. E. Myers has formed the Topeka (Kan.) Edison Company to take over the business of the Edison Electric Illuminating Company, and will spend $200,000 in improving the plant.

The Ohio Steel Furniture Company, of Youngstown, O., has been incorporated with a capital of $100,000, and will erect a plant for the manufacture of desks, etc., of steel. S. S. Conroy, James A. Murphy and others, incorporators.

Farley Osgood, manager of the New Milford (Conn.) Power Company, as representative, purchased some property, which will be converted into a plant for the manufacture of electrical supplies.

The Pratt Construction Company has been incorporated with a capital of $25,000, and will erect a plant in Decatur, Ill., for the manufacture of oil-extracting machinery. F. M. Pratt, Chas. F. Pratt, etc., incorporators.

New Catalogues.

The P. A. Geier Company, Cleveland, Ohio. Circular illustrating and describing the Geier boring tool holder.

The Adams Company, Dubuque, Iowa. Circular illustrating the Farwell miller, for use in combination with iron planer.

Massey Machine Company, Watertown, N. Y. Catalogue describing the "Ring Turret" lathe. Illustrated. 6x9, pp. 21, paper.

The Heald Machine Company, Worcester, Mass. Circular relating to new ring and surface grinder and other tools. Illustrated.

The General Pneumatic Tool Company, Montour Falls, N. Y. Mailing card illustrating and describing Shepard roller bearing trolleys.

Yale & Towne Manufacturing Company, 9 Murray street, New York. Catalogue describing portable electric hoists. Illustrated. 6x9, pp. 8, paper.

Ingersoll-Sergeant Drill Company, 11 Broadway, New York. Catalogue No. 60, describing stone-channeling machine. Illustrated. 6x9, pp. 47, paper.

Nanz & Co., 127 Duane street, New York. Catalogue of watchmen's time detectors, employees' time recorders, etc. Illustrated. 6x9, pp. 16, paper.

Scully Steel & Iron Company, Chicago, Ill.; 39 Cortlandt street, New York. November and December stock list. Illustrated. 4½x7, pp. 144, paper.

National Electric Company, Milwaukee, Wis. Bulletin No. 358, describing belt-driven alternating-current generators. Illustrated. 7x10, pp. 16, paper.

Crocker-Wheeler Co., Ampere, N. J. Bulletin No. 61 (superseding No. 46), describing belt-type direct-current machines, large sizes. Illustrated. 7½x10, pp. 12, paper.

Flexible Metallic Tubing Company, 178 Washington street, New York. Catalogue of flexible metallic tubing, showing its application to various purposes. Illustrated. 8x10, pp. 40.

The Hamilton Machine Tool Company, Hamilton, O. Booklet No. 4, containing illustrations of some of the tools built by this company and a complete list of sizes. 3½x6, pp. 17, paper.

C. Lee Cook Manufacturing Company, Louisville, Ky. Catalogue of metallic packing of all descriptions for steam and air for reciprocating and turbine engines. Illustrated. 6x9, pp. 32, paper.

E. F. Houghton & Co., 240-250 West Somerset street, Philadelphia, Pa. Catalogue illustrating the principal methods for applying the Marck steam trap, as well as a few to avoid. 5x7½, pp. 32, paper.

Gould & Eberhardt, Newark, N. J. Catalogue "C," 1905, of "High Duty" shapers and attachments. This is a very attractive catalogue containing excellent half-tone illustrations. 6x9, pp. 50, paper.

Stark Tool Company, Waltham, Mass. Catalogue, printed in four languages—English, German, French and Spanish—describing machinists' bench lathes and precision machinery. Illustrated. 6x9, pp. 42, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

M. R. E. Mathot, the well-known Belgian gas engine expert and author, is visiting the United States, and invites correspondence and consultation. His itinerary is as follows: Detroit, Nov. 18; Chicago, Nov. 21; Cincinnati, Nov. 30; New York, Dec. 11. Correspondence addressed to M. Mathot, in care of the American Society of Mechanical Engineers, 12 West 31st st., New York, will be forwarded.

For Sale.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

Machine Shop for Sale.—Here is a great opportunity for someone who wants a business of his own. This is a modern plant, lo-

cated in central New York. Main building, 100x60 ft., two stories, equipped with about 60 high-grade machine tools, including lathes, milling machines, shapers, drills, etc. Plant is adapted for automobile or any high-grade work, and is now running. This plant and business cost more than $50,000, and we can sell it for less than $12,000, if taken promptly. This price includes land, buildings and machinery, also patents, jigs and tools for making a very profitable specialty. To the right parties we can make very favorable terms. William A. Reade & Co., 402 Chamber of Commerce Bldg., Cleveland, Ohio.

Business Opportunities.

A prosperous foundry and machine works in Atlanta, Ga., desires to arrange with manufacturers or patentees for the right to manufacture staple articles of steel and iron suitable for sale in the South. Box 787, AM. M.

A consulting engineer, in active general engineering practice, desires to purchase an interest in a suitable manufacturing business, and preferably near Chicago, Ill. Address George W. Scott, 1302 Security Building, Chicago, Ill.

Young, thoroughly practical, expert machinist, 10 years' experience with internal-combustion engine, is open to invest in established business, where experience and enterprise will count, with some cash capital; best of references. Address "Hustler," care AM. M.

For Sale—Patented machine shop specialty, which has been manufactured in a small way; anyone wishing a good selling specialty to manufacture in conjunction with his own line should investigate; would allow it to be manufactured on royalty. Address "R. E. H.," care AMERICAN MACHINIST.

Wanted—Practical accountant and business man as treasurer of an established manufacturing business; must be able to show a successful record as accountant and office man, and invest from $5,000 to $10,000 in stock of company. Address, with full particulars of experience, ability and references, "J. B.," care AMERICAN MACHINIST.

Large Profits. Novelty for Lifting Apparatus, and Machine Factories. For Sale for America—The rights of manufacture and sale of a Railroad-Track Lifting Screw, protected by patents in Germany and most of the civilized countries. Offers to be addressed sub 317 E. M., Mr. Adolf Beisser, Advertising Agency, Nürnberg, Germany.

Wanted—An experienced foundryman to join others in the purchase and operation of an established job foundry with an assured tonnage of 100 to 150 tons per month; must be able to show a successful record and invest from $5,000 to $10,000. Address, with full details of experience in mixing metals, managing help, references, etc., "G. P. M.," AM. M.

I want a partner with $10,000 to establish plant and manufacture marine specialty in universal use and demand. Not a revolutionizing invention, but a standard article, depending for its market on high quality at low manufacturing cost, owing to improved and simplified construction; fully protected; absolutely no competition in its class. This is an exceptional opportunity for anyone seeking an interest in light, clean manufacturing business which will yield investor 60% annually. I have facts, not figures, to prove what I say, including advance orders of over $1,000, actually in hand from test advertisements and shown samples. No experimenting; everything ready to go ahead, including bids on equipment. Advertiser is a practical man and a hustler. Do not answer this unless you mean prompt business if above is proved to your satisfaction. Box 823, AMER. MACH.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Mechanical engineer, technical graduate, wants position as assistant engineer or chief draftsman; age 29; 6 years' experience; 2½ years chief draftsman. Box 833, AM. MACH.

General manager, with large experience in organizing new and old manufacturing plants in United States and Canada, is open for engagement; technical graduate; age 35. Box 798, AMERICAN MACHINIST.

ILLINOIS.

An experienced mechanical draftsman and designer wants a position. Address Box 837, AMERICAN MACHINIST.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

MASSACHUSETTS.

Young man, experienced in drafting and designing textile machinery; New England. Box 811, AMERICAN MACHINIST.

MICHIGAN.

Superintendent wants position; New England man, age 39; good manager; a hustler; systematic; good mechanic and up in foundry practice; good references. Box 749, AM. M.

NEW JERSEY.

Position as superintendent, by a practical, up-to-date man, familiar with the latest shop methods; 11 years' experience in charge of help; best of references to those who desire the services of a hustler; New York or vicinity. Box 832, AMERICAN MACHINIST.

NEW YORK.

Competent mechanical draftsman wants position; New York or vicinity. Box 825, A. M.

Automatic machine designer is open for engagement. Address "Automatic," Box 835, AMERICAN MACHINIST.

Experienced man in piece and cost work desires situation. Address "Practical," care AMERICAN MACHINIST.

Ambitious young man wishes position as salesman; several years' experience in steel line. Box 834, AMERICAN MACHINIST.

Wanted—A position as foreman or working foreman in a jobbing foundry. Address P. H. Sharp, care AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, extensive experience in drafting room and shop, wishes position. Box 841, AM. MACH.

Young man (experience, 1 year superintending, 4 drafting, 3 machine shop) wants position, assistant to foreman or superintendent of manufacturing concern. Box 828, AM. M.

Wanted—Position as assistant superintendent, by designer automatic machines, jigs, fixtures; 6 years' shop experience; technical graduate; married; go anywhere. Box 826, AMERICAN MACHINIST.

Graduate M. E. (age 30); 2 years shop, 9 years office, as designer, inspector, etc., on special and small machinery, jigs, fixtures, instruments and experimental work; practical and inventive man; shop or office position, or both. Box 801, AMERICAN MACHINIST.

Position as superintendent; experienced and competent in pattern foundry and machine shop; good executive and organizer; well up in labor-saving appliances and modern manufacturing; can produce results; now holding position of responsibility; good reason for seeking change; references. Box 842, AM. M.

OHIO.

Graduate M. E., 29, also practical machinist and licensed engineer, with business and shop experience, desires to represent an engineering or manufacturing concern in Cleveland district. Address Box 843, AM. MACH.

PENNSYLVANIA.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Wanted.—Chief draftsman and designer, familiar with grinding machinery and special machines, wishes to make a change; age 30; technical education, shop experience, and executive. Box 839, AMERICAN MACHINIST.

Superintendent of machine and iron works; many years' practical experience; skilled in design, invention and difficult construction; familar wth details of modern shop practice; advantageous handling of help, etc.; open for engagement; high and responsible references. Address Box 804, AMERICAN MACHINIST.

WISCONSIN.

Situation wanted by a superintendent desiring a change; 39 years; in the prime of a healthy life; extensive experience on special and automatic machinery, tool building and designing, gas, gasolene, producer and producer engines; a hustler, with a forte for putting old and new plants in shape to produce a maximum of high-grade work at a minimum cost, based on the simplest and most practical of modern ideas; go anywhere; A1 reference. Address Box 836, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—For large electrical factory in Canada, several first-class mechanics as foremen and inspectors in machine shop. Apply, stating experience and wages, to Box 808, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—At once, two first-class draftsmen, capable of designing machinery for mill work; must be reliable and energetic; in applying, state experience in detail, age and salary desired. Address Box 840, AMER. MACHINIST.

Several first-class, all-around machinists are wanted by firm manufacturing elevators, clay-working machinery, friction clutches, etc.; men capable of doing erecting or repair work when required; steady work for right men. The Eastern Machinery Co., New Haven, Conn.

We are constantly adding to our force, and invite applications from machinists, toolmakers, diesinkers, drop forgers, erectors and patternmakers, also lathe, screw machine and bench hands; in applying, please state age, experience and wages wanted. Locomobile Company of America, Bridgeport, Conn.

INDIANA.

Help Wanted.—Large concern in Middle West, with rapidly increasing business and in process of reorganization, with foundry, machine shops, sheet metal, automobile, woodworking and millwright departments, desires applications from executives, foremen, draftsmen, cost and production clerks and skilled mechanics; none considered but those accustomed to modern organization methods; state experience and salary expected. Address Box 831, AMERICAN MACHINIST.

MARYLAND.

Toolmakers wanted on automobile work; competent toolmakers; must be first-class men who will appreciate steady employment. Address Pope Manufacturing Company, Hagerstown, Md.

MASSACHUSETTS.

Wanted—Mechanical draftsmen with at least 2 years' practical experience; preferably in connection with pattern work. Box 824, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good, all-round men on special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

Wanted—Foremen for brass-finishing department of factory in Cambridge, Mass.; must be experienced, a believer in piece work and capable of turning out goods at a profit. Address A. T. H., P. O. Box 5077, Boston, Mass.

Wanted—First-class engineer to take charge of power plant, containing up-to-date compound condensing engines, boilers, electrical generators and motors; works situated in central Massachusetts; state age, experience and compensation expected. Box 807, AM. MACH.

MICHIGAN.

Wanted—Draftsman who is thoroughly familiar with jig and tool designing, also familiar with automobile work, to assist chief draftsman; also draftsman for checking, who is familiar with automobile work. Box 797, AMERICAN MACHINIST.

Wanted—We still have room for a few more first-class toolmakers. If you have had good experience on making jigs, fixtures and test tools for interchangeable machinery and would like to get a position in an up-to-date tool department, with good wages, write to the Cadillac Motor Car Co., Detroit, Mich.

Wanted—Foreman to take charge of field-winding and insulating department; must be steady and familiar with latest improved methods of field coil winding; reply in full, giving age, reference, married or single and salary expected; to receive consideration, applicant must give above information in detail. Box 809, AMERICAN MACHINIST.

NEW HAMPSHIRE.

Draftsman, capable of laying out work for detailers in line of steam engines, air compressors, etc.; give experience, references and pay expected. Box 829, AMER. MACHINIST.

Stockkeeper, experenced in modern stock practice in machinery manufacture; capable of taking charge of stock department of large factory; give experience, references and pay expected. Box 830, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—By manufacturing concern near Newark, two mechanical draftsmen at once; must be accurate; permanent position. Box 795, AMERICAN MACHINIST.

Wanted—First-class mechanical designer and draftsman, who has had experience on printing presses and printing machinery. Aluminum Press Company, Dunellen, N. J.

Lathe, planer and boring mill operators

wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

NEW YORK.

Wanted—Bright young man as inspector of finished parts in typewriter works. Box 827, AMERICAN MACHINIST.

Wanted—Bright young men with mechanical inclinations, to become machinists in special line. Address Box 800, AMER. MACH.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N Y.

Wanted—First-class patternmaker, experienced in flanged fitting work and valves; splendid opening for a man of unusual ability. Address Box 822, AMERICAN MACHINIST.

Wanted—A chemist; one familiar with strength of materials, also the best foundry practice; must be able to recommend material to accomplish certain results. Box 817, A. M.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Bright young mechanic, familiar with small fine work, to learn to care for some special machinery in a manufacturing plant; will pay $20 per week, or better, to satisfactory man; non-union preferred. Apply to Box 799, A. M.

Milling machine operators, capable of setting up their own machines, reading blueprints and being able to do first-class tool machine work; if not first-class, do not apply. Address G. M. H., Box 129, 617 6th ave., New York City.

Wanted—General foreman for night shift, by company building air compressors, etc.; in applying, state age, reference, present employers, length of present service and wages expected; all applications treated strictly confidential. Address Box 844, AMER. MACH.

Wanted—Superintendent for machine shop employing about 250 men; must be good mechanic, with executive ability; must be thoroughly competent and experienced on printing presses, tools and interchangeable machinery; only first-class men with successful records need apply, giving experience, reference, etc. Address "Newark," care AMER. MACHINIST.

Tool Designer.—A company of established reputation, employing 1,600 hands, requires a man to devise tools and manufacturing methods for producing large quantities of small, strictly interchangeable parts; he will be responsible for results to one man only, and will be assisted by the chief draftsman and his staff; applicants will please state age, nationality and extent of education; also give a list, covering present and former positions, specifying the name of each employer, the nature of each position held and the dates between which employed; this information is requested on the understanding that it will be treated as strictly confidential; no inquiries will be addressed to any person you mention, without first obtaining your consent. Address "Confidential," Box 821, AM. MACH.

OHIO.

Wanted—First-class man for case-hardening. Box 802, AMERICAN MACHINIST.

Wanted—In Cleveland, O., foreman to take charge of punch and die makers on metal stampings; state how long and where formerly employed, also salary expected; none but first-class need apply. Box 838, AMER. MACH.

Wanted—A mechanical draftsman, experienced in steam engine designing; must be a technical graduate, capable of doing the routine figuring of the drafting room; state age, experience, education and salary expected. Address The Hooven, Owens, Rentschler Co., Hamilton, O.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMER. MACHINIST.

Wanted—Machinists and patternmakers. We are constantly adding to our force, and invite applications from machinists and patternmakers, preferably those accustomed to engine work. Shepherd Engineering Company, Franklin, Pa.

Erecting foreman; experienced on high-grade machine tools; location, Pennsylvania N. W.; new works; every facility; only competent men with record for accurate work and ability to manage men and work economically need apply; state past employers, capacity and length of service, age, nationality, etc.; letters confidential, returned if desired. Address Box 796, AMERICAN MACHINIST.

VIRGINIA.

Mechanical draftsman wanted who understands machine design and repairs and has practical shop experience; prefer one who has worked under a shop engineer; state experience and salary expected. Address "L. N. G.," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted.—A new machinery house opening in St. Louis desires the services of a machine tool salesman of first-class ability and experience; in answering, state age, references, salary expected, average annual sales for the past 3 years and lines of tools sold. Box 820, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co. 22
Acme Machinery Co. 34
Adams Co., The. 95
Albro-Clem Elevator Co. 103
Allington & Curtis Mfg. Co. 87
Almond Mfg. Co., T. R. 107
American Gas Furnace Co. 14
American Pulley Co. 29
American Tool & Machine Co. 98
American Tool Works Co. 8
American Tube & Stamping Co. 94
American Watch Tool Co. 92
Armstrong Bros. Tool Co. 28 and 107
Auburn Ball Bearing Co. 96
Aurora Tool Works. 105
Automatic Machine Co. 96

Baird Machinery Co. 90
Bair & Gazzam Mfg. Co. 103
Baker Brothers. 87
Baldwin Chain & Mfg. Co. 97
Baldwin Steel Co. 108
Ball Bearing Co. 34
Barnes Co., B. F. 97
Barnes Co., W. F. & John. 14
Barnett Co., G. & H. 4th Cover
Bartlett, E. E. 92
Bay State Stamping Co. 101
Bay State Tap & Die Co. 90
Beaman & Smith Co., The. 15 and 106
Becker-Brainard Milling Machine Co. 1
Bertram & Sons Co., Ltd., John. 14
Besly & Co., Chas. H. 92
Bethlehem Fdry. & Mach. Co. 109
Bickford Drill & Tool Co. 10
Bignall & Keeler Mfg. Co. 100
Bilgram, Hugo. 34
Billings & Spencer Co. 95
Binsse Mach. Co. 34 and 79
Birdsboro Steel Foundry & Machine Co. 94
Blaisdell Machinery Co. 93
Blanchard Mach. Co. 34
Bliss Co., E. W. 25
Blount Co., J. G. 22
Boker & Co., Hermann. 83
Booth, Wm. M. 28
Boston Gear Works. 102
Boynton & Plummer. 90
Bradford Machine Tool Co. 5
Bridgeford Mach. Tool Works. 16
Bridgeport Safety Emery Wheel Co. 87
Bristol Co. 4th Cover
Brown-Cochran Co. 100
Brown & Co., R. H. 106
Brown & Sharpe Mfg. Co. 73 and 4th Cover
Brown Hoisting Mach. Co. 105
Buffalo Forge Co. 4th Cover
Builders Iron Foundry. 3d Cover
Bullard Auto. Wrench Co. 101

PAGE

Bullard Machine Tool Co. 32
Bury Compressor Co. 87
Butler, A. G. 87

Caldwell & Son Co., H. W. 103
Carborundum Co., The. 25
Card Mfg. Co., S. W. 17
Carpenter Tap & Die Co., J. M. 90
Case Mfg. Co. 105
C & C Electric Co. 27
Chambersbirg Engr. Co. 91
Chattanooga Machinery Co. 98
Chicago Rawhide Mfg. Co. 103
Christensen, N. A. 87
Cincinnati Machine Tool Co. 33
Cincinnati Milling Mach. Co. 6 and 7
Cincinnati Planer Co. 9
Cincinnati Shaper Co. 110
Clark Cast Steel Cement Co. 97
Clark, Jr., & Co., Jas. 101
Cleveland Automatic Mch. Co. 18
Cleveland Crane & Car Co. 105
Cleveland Pneumatic Tool Co. 87
Cleveland Twist Drill Co., The. 4th Cover
Clough, R. M. 104
Coates Clipper Mfg. Co. 96
Coes Wrench Co. 23
Colburn Machine Tool Co. 22
Columbus Machine Co. 100
Cook Co., Asa S. 109
Cornell, J. B. & J. M. 108
Crescent Forgings Co. 93
Cresson Co., Geo. V. 87
Crocker-Wheeler Co. 29
Crosby Steam Gage & Valve Co. 17
Cumberland Steel Co. 101
Curtis & Co. Mfg. Co. 105
Curtis & Curtis Co. 87
Cushman Chuck Co. 106
Cutler-Hammer Clutch Co. 28

Dallett Co., Thomas H. 31
Davis, Rodney. 104
Desmond-Stephan Mfg. Co. 99
Detrick & Harvey Mach. Co. 22
Diamond Machine Co. 3d Cover
Dill Machine Co., T. C. 22
Dixon Crucible Co., Joseph. 101
Dodge & Day. 98
Dreses Machine Tool Co. 85
Druckleib, C. 87
Dwight Slate Machine Co. 104

Earle Gear & Mach Co. 102
Eberhardt Bros. Machine Co. 102
Eck Dynamo & Motor Wks. 28
Electro-Dynamic Co. 26
Errington, F. A. 107
Evans Friction Cone Co. 108
Excelsior Needle Co. 101

Fairbanks Co. 90 and 92
Farrel Fdry. & Machine Co. 108

PAGE

Fawcus Machine Co. 104
Fellows Gear Shaper Co. 104
Fenn-Sadler Machine Co. 96
Firth-Stirling Steel Co. 108
Fitchburg Machine Works. 24
Foos Gas Engine Co. 100
Fosdick Machine Tool Co. 15
Franklin Mfg. Co. 95

Garvin Machine Co., The. 95
Geier Co., P. A. 97
General Electric Co. 26
General Mfg. Co. 101
General Pneumatic Tool Co. 93
Geometric Tool Co. 23
Gilmore Electric Co. 102
Gleason Works. 4th Cover
Goldschmidt Thermit Co. 108
Gorton Machine Co., Geo. 107
Gould & Eberhardt. 77
Graham Mfg. Co. 100
Grant Gear Works. 102
Gray Co., G. A. 34
Gray & Prior Machine Co. 100
Greaves, Klusman & Co. 107
Greenwald Co., I. & E. 104

Hammacher, Schlemmer & Co. 79
Hampden Corundum Wheel Co. 99
Harrington, Son & Co., Inc., Edw. 94
Hartford Steam Boiler Insp. & Ins. Co. 100
Hendey Machine Co. 81
Henley Publishing Co., Norman W. 87
Henry & Wright Mfg. Co. 99
Heppenstall Forge & Knife Co. 109
Hess-Bright Mfg. Co. 105
Hill, Clarke & Co. 88 and 90
Hilles & Jones Co. 90
Hinckley, F. C. 96
Hisey-Wolf Machine Co. 101
Hoefer Mfg. Co. 14
Hoggson & Pettis Mfg. Co. 106
Horton & Son Co., E. 106
Horsburgh & Scott Co. 4th Cover
Hunt Co., C. W. 105
Hunt & Co., Robt. W. 97
Hyatt Roller Bearing Co. 91

Ide & Sons, A. L. 88
Ingersoll Milling Mach. Co. 96
Ingersoll-Rand Co. 20
International Specialty Co. 99
Iroquois Machine Co. 93

Jacobs Mfg. Co. 106
Jacobson Mach. Mfg. Co. 100
Jantz & Leist Electric Co. 28
Jeffrey Mfg. Co., The. 88
Jenkins Brothers. 101
Johnson Machine Co., Carlyle. 83
Jones & Lamson Machine Co. 12 and 34

PAGE

Keep, W. J. 98
Kelsey, Duane J. 90
Kent & Co., Edwin R. 108
Kilbourne & Jacobs Mfg. Co. 96
King Machine Tool Co. 98

Landis Machine Co. 98
Landis Tool Co. 75
Lapointe Machine Tool Co. 107
Le Blond Machine Tool Co., R. K. 4th Cover
Le Count, Wm. G. 106
Link-Belt Engineering Co. 85
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The. 109
Lucas, J. L. 90
Lunkenheimer Co., The. 101

McBarron Co. 96
McCabe, J. J. 31 and 88
McGlehan & Co., C. H. 98
McInnes Steel Co. 108
Maris Bros. 105
Marshall & Huschart Mch. Co. 89
Massachusetts Saw Works. 106
Massey Machine Co. 33
Mechanical Accountant Co. 98
Merrell Mfg. Co. 97
Merritt & Co. 88
Mersfelder Pattern Co. 89
Mietz Iron Fdry. & Mach. Works, August. 100
Millers Falls Co. 97
Miner & Peck Mfg. Co. 100
Moore Co., Franklin. 105
Morse Chain Co. 91
Morse Twist Drill & Mach. Co. 33
Morse, Williams & Co. 104
Motch & Merryweather Mchry. Co. 89
Mueller Mach. Tool Co. 101
Mutual Machine Co. 98

National-Acme Mfg. Co. 110
National Corundum Wheel Co. 99
New Britain Machine Co. 109
New Era Gas Engine Co. 100
New Haven Mfg. Co. 106
New Process Raw Hide Co. 103
New Process Twist Drill Co. 30
Newton Mach. Tool Wks., Inc. 11
Nicholson File Co. 17
Nicholson & Co., W. H. 107
Niles-Bement-Pond Co. 88, 90, 111, 112, 113 and 114
Northern Electrical Mfg. Co. 27
Northern Engineering Works. 105
Norton Emery Wheel Co. 9
Norton Grinding Co. 16
Nuttall Co., R. D. 102
Nutter, Barnes & Co. 109

Obermayer Co., S. 108
Oil & Waste Saving Mach. Co. 91
O. K. Tool Holder Co. 98
Owen Machine Tool Co. 107

	PAGE
Parker Co., Chas.	100
Patterson, Gottfried & Hunter, Ltd.	94
Pawling & Harnischfeger	105
Paxson Co., J. W.	28
Philadelphia Bourse	99
Philadelphia Gear Works	102
Phillips & Sons Co., F. R.	97
Phoenix Mfg. Co.	87
Poole Co., J. Morton	91
Potter & Johnston Mach. Co.	81
Pratt Chuck Co.	106
Pratt & Whitney Co.	2 and 3
Prentiss Tool & Supply Co.	88
Ransom Mfg. Co.	99
Reed Mfg. Co.	100
Reeves Pulley Co.	25
Reichhelm & Co., E. P.	4th Cover
Reliance Machine & Tool Co.	89
Rivett-Dock Co.	3d Cover
Rivett Lathe Mfg. Co.	3d Cover
Robbins, L.	104
Rogers, Boat, Gage & Drill Works, John M.	24
Rowbottom Machine Co.	99
Safety Emery Wheel Co.	99
Saunders' Sons, D.	96
Sawyer Gear Works	102
Schieren & Co., Chas. A.	97
Schumacher & Boye	9
Schwerdtle Stamp Co.	96
Scranton & Co.	92
Sebastian Lathe Co.	28
Sellers & Co., Inc., William	34
Seneca Falls Mfg. Co.	30
Shaw & Co.	97
Shelby Steel Tube Co.	109
Shultz Belting Co.	109
Sibley Machine Tool Co.	97
Simonds Mfg. Co.	102
Skinner Chuck Co.	106
Slocomb Co., J. T.	28
Smith & Mills	106
Speed Changing Pulley Co.	99
Spicer Universal Joint Mfg. Co.	30
Sprague Electric Co.	26
Springfield Machine Tool Co.	24
Stafford, H. E.	90
Standard Engineering Works	30
Standard Gauge Steel Co.	104
Standard Tool Co.	93
Stanley G. I. Elec. Mfg. Co.	29
Stark Tool Co.	104
Starrett Co., L. S.	13
Steptoe Shaper Co., John	98
Stevens, F. B.	108
Stoever Fdry. & Mfg. Co.	97
Struthers-Wells Co.	100
Sturtevant Co., B. F.	13
Switchboard Equipment Co.	29
Syracuse Raw Hide Co.	103
Taylor-Wilson Mfg. Co.	104
Three Rivers Tool Co.	14
Triumph Electric Co.	28
Trump Brothers Machine Co.	106
Underwood & Co., H. B.	30
Union Twist Drill Co.	77
U. S. Foundry & Sales Co.	108
Vanderbeek Tool Works	100
Vandyck Churchill Co.	19
Veeder Mfg. Co.	98
Vitrified Wheel Co.	99
Wallace Supply Co.	89
Ward & Sons, Edgar T.	108
Warner Instrument Co.	96
Warner & Swasey Co.	75
Watson-Stillman Co.	30
Waterbury Farrel Foundry & Mach. Co.	97
Webster & Perks Tool Co.	99
Wells Bros. Co.	31
West Haven Mfg. Co.	4th Cover
Westinghouse Elec. & Mfg. Co.	27
Westmacott Co., J. M.	107
Whitcomb-Blaisdell Machine Tool Co.	21
Whitman & Barnes Mfg. Co.	33
Whitney Mfg. Co.	71
Whiton Mach. Co., D. E.	106
Wiley & Russell Mfg. Co.	30
Wiley & Sons, John	34
Williams & Co., J. H.	90
Wilmarth & Morman Co.	99
Windsor Machine Co.	108
Winkley Co.	101
Wood's Sons, T. B.	91
Woodward & Powell Planer Co.	30
Worcester Mach. Screw Co.	106
Wormer Machinery Co., C. C.	89
Wright, Harold A.	96
Wyke & Co., J.	96
Wyman & Gordon	4th Cover
Yale & Towne Mfg. Co.	97 and 105

Classified Index of Articles Advertised.

Abrasive Materials
Abasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air
Ingersoll-Rand Co., New York.

Air Lifts
Ingersoll-Rand Co., New York.

Arbors
Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Arbor Presses
Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Dodge & Day, Philadelphia, Pa.

Auctioneers
Shaw & Co., New York.

Ball Bearings
See Roller Bearings.

Bars, Boring
Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
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Underwood & Co., H. B., Philadelphia, Pa.

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Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.

Bending Machinery, Plate *Continued*
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand
Wallace Supply Co., Chicago, Ill.

Bicycle Parts
Standard Welding Co., Cleveland, Ohio.

Blocks, Chain
See Hoists, Hand.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Cornell Co., J. B. & J. M., New York.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines
General Electric Co., New York.

Boilers
Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Wiley & Sons, Jno., New York.

Boosters
Burke Electric Co., Erie, Pa.
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.

Boring and Turning Mills *Continued*
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Broaching Presses
Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Bulldozers
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

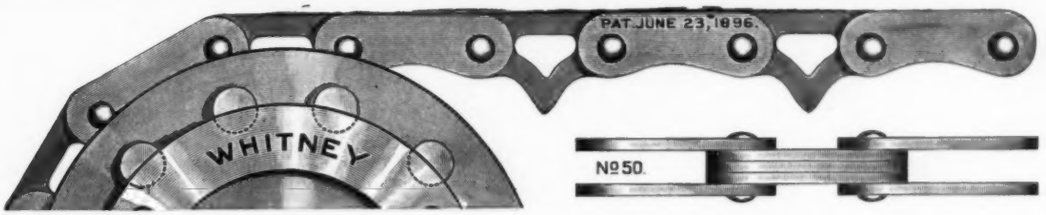
Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cornell Co., J. B. & J. M., New York.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

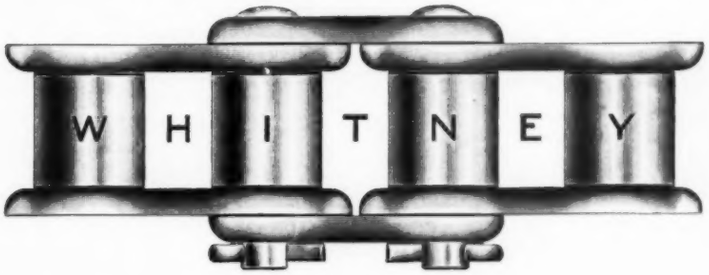
Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

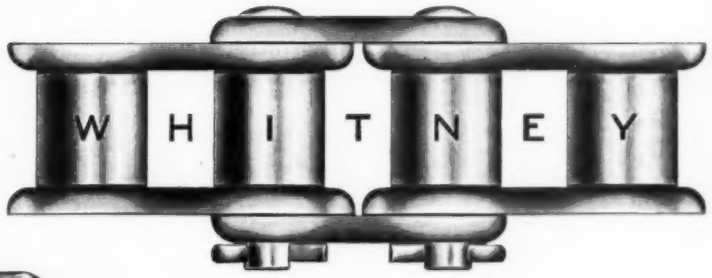
Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.



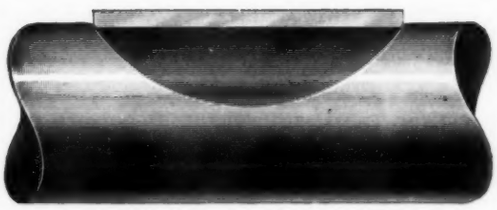
"WIZARD" Chains and Sprockets—Patented



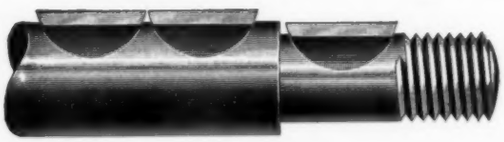
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartfrod, Ct.

Chemists
Booth, Wm. M., Syracuse, N. Y.

Chisels, Cold
Anderson & Sons Co., Detroit, Mich.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
American Tool & Mach. Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.

Clutches, Friction—*Cont'd*
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
McGiehan & Co., C. H., New York.

Controllers and Starters Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold A., New York.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N.Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co, Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.

Cutting-off Machines—*Cont'd*
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

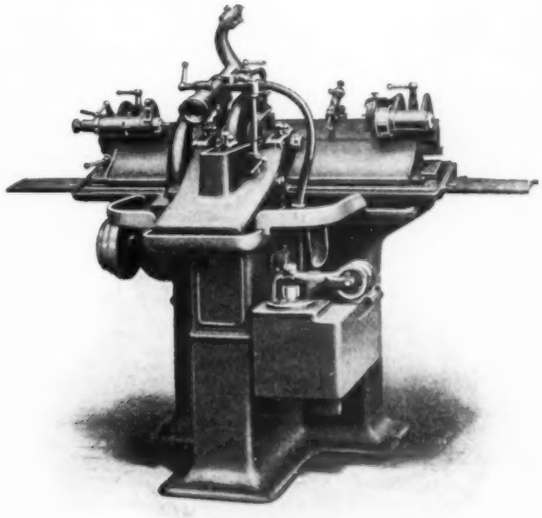
Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Dwight Slate Mach. Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U.S.A.

The Automatic Cross Feed On Brown & Sharpe Grinding Machines

is advantageous in grinding a large number of pieces accurately to size. The production is increased and the cost of the finished work reduced to a minimum.



FEATURES:

1. Range, .00025" to .004".
2. It forms an integral part of the machine.
3. When work is to size feed is automatically thrown out.
4. Feed can be set to full amount at one end of table travel, or part at one end and part at the other.
5. Mechanism is operated by dogs on front of the table.
6. It is regulated by the simple pressing of a thumb latch which sets the feed for the desired size.
7. Feeding mechanism operates before table reverses.
8. Table can be reversed between the points of travel without feeding the wheel to the work.

Catalog and circulars describe the grinding machines in detail.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Hamilton Mach. Tool Co., Hamilton, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Clark, Jr., & Co., Jas., Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Extractors
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadephia, Pa.
New Britain Mach. Co., New Britain, Conn.

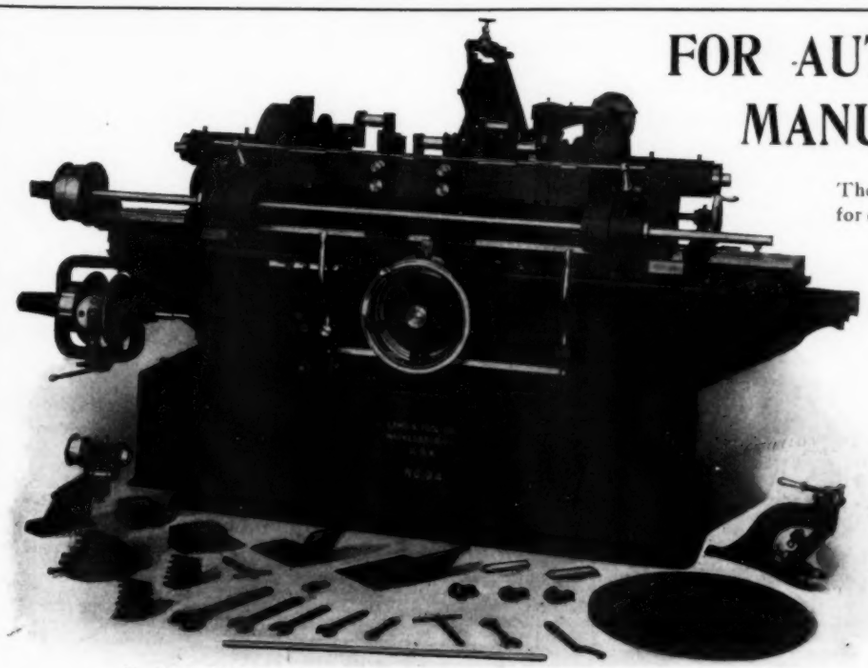
Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.



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Absolutely perfect crank shafts guaranteed.

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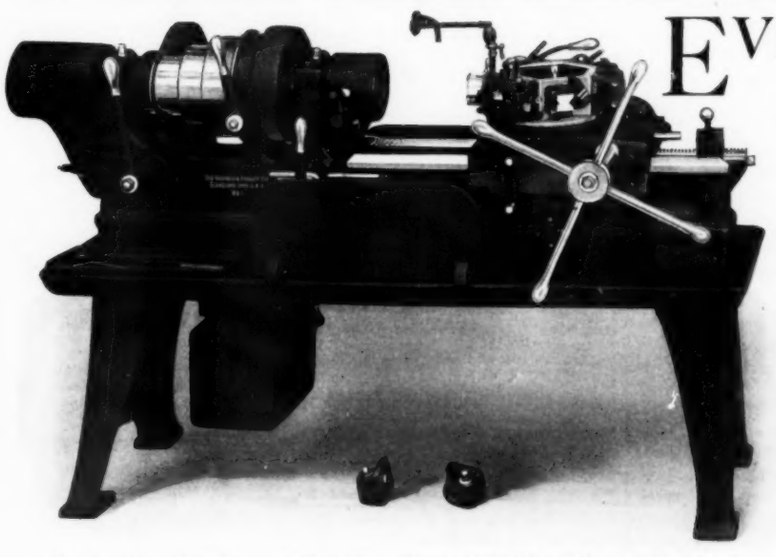

No. 1—1⅜ x 15 inches. Other sizes:—No. 2, 2¼ x 24 and No. 3, 3⅝ x 36 inches.

EVERY SIZE MOST ECONOMICAL for work strictly within its range

No. 1 Hollow Hexagon Turret Lathe, here illustrated, for small work—1⅜" diameter and smaller in lengths up to 15"—greatest rapidity and ease in operation—GREATEST OUTPUT.

Larger machines for larger work.

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Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwad Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
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Burke Electric Co., Erie, Pa.
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General Electric Co., New York.
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Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
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Diamond Mach. Co., Prov., R. I.
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Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
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Niles-Bement-Pond Co., New York.

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Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & Jno., Rockford Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
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Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
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Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
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Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Il.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
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Chicago Flexible Shaft Co., Chicago, Ill.

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Caldwell & Son Co., H. W., Chicago, Ill.
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Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

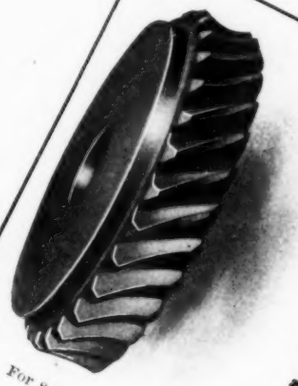
Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel
Sprague Elec. Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.



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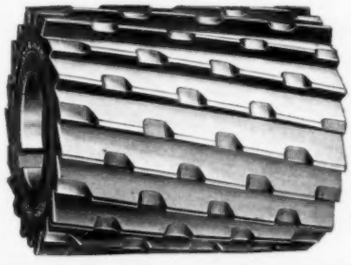

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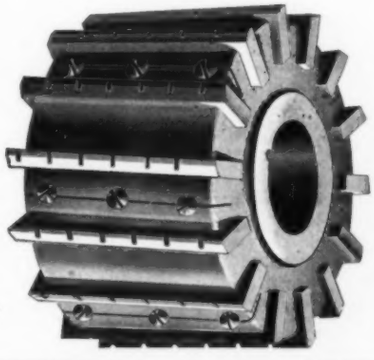

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Phila. Store, Field & Co., Mgr., 53 North 5th St.
London Agents, Chas. Neat & Co., 112 Queen Victoria St.

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Warner Instrument Co., Beloit, Wis.

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Hunt Co., C. W., West New Brighton, N. Y.

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International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

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General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

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Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

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Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
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Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
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Whitney Mfg. Co., Hartford, Ct.

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Standard Gauge Steel Co., Beaver Falls, Pa.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Ct.

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Phillips & Sons Co., F. R., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

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Gilmore Electric Co., South Boston, Mass.
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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathe Dogs
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Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.

Lathe Dogs—*Continued*
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Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

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Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
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Blount Co., J. G., Everett, Mass.
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Bullard Mach. Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
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Lathes, Wood
Prentiss Tool & Supply Co., New York.
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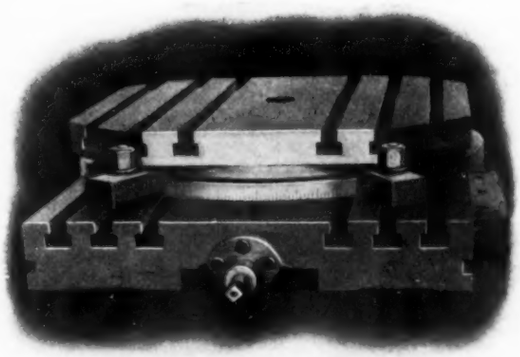

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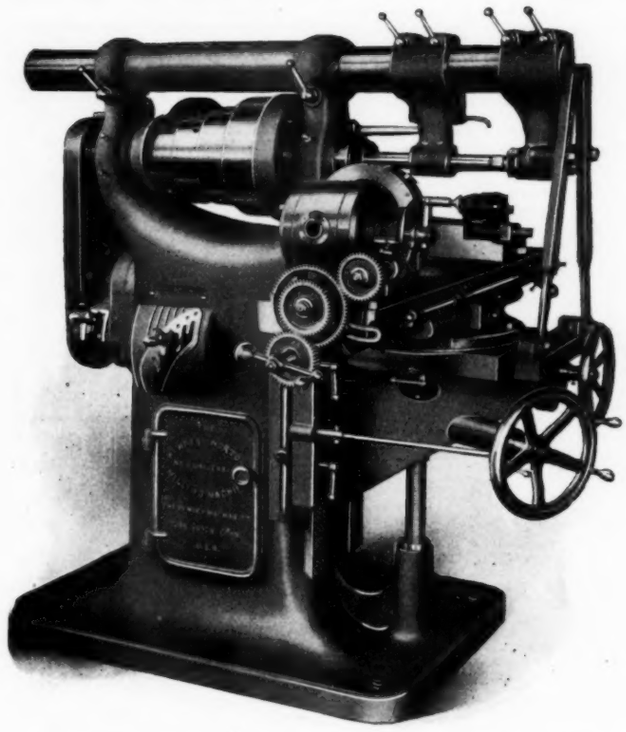

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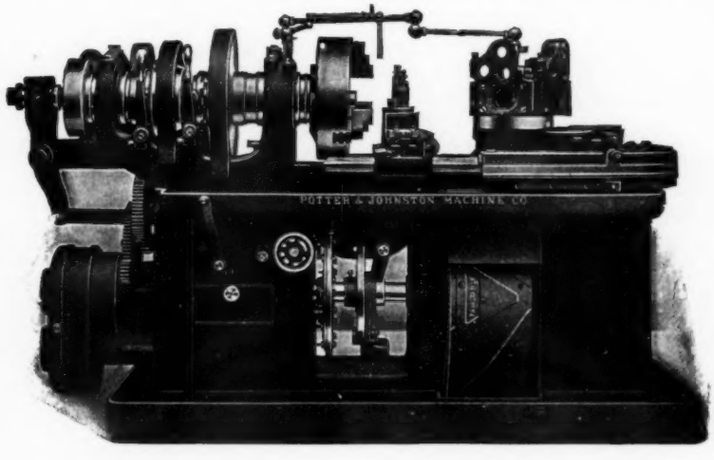

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Hammacher, Schlemmer & Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Standard Gauge Steel Co., Beaver Falls, Pa.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Ide & Son, A. L., Springfield, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.

Second Hand Machinery *Continued*
Motch & Merryweather Mchry. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Cresson Co., Geo. V., Phila., Pa.
General Electric Co., New York.

Separators, Oil and Steam
American Tool & Mach. Co., Boston, Mass.
National Separator & Mach. Co., Concord, N. H.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Shafting
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Pressed Steel Mfg. Co., Philadelphia, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Cochrane-Bly Co., Rochester, N. Y.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hamilton Mach. Tool Co., Hamilton, O.
Hendey Mach. Co., Torrington, Ct.
Kelly Mach. Co., R. A., Xenia, O.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cin., O.
Vandyck Churchill Co., New York.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmintgon, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Shears, Rotary
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.

Sheet Metal Working Machinery
Bartlett, E. E., Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Swaine Co., Fred J., St. Louis, Mo.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bartlett, E. E., Boston, Mass.
Betts Mach. Co., Wilmington, Del.

Slide Rests—*Continued*
Blount Co., J. G., Everett, Mass.
Garvin Mach. Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Slotters
Baker Bros., Toledo, O.
Betts Machine Co., Wilmington, Del.
Dill Mach. Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
National-Acme Mfg. Co., Cleve., O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Sockets and Sleeves
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Standard Tool Co., Cleveland, O.

Special Machines and Tools
Automatic Mach. Co., Bridgeport, Conn.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Cleveland Cap Screw Co., Cleveland, O.
Crescent Forgings Co., Oakmont, Pa.
Dallett Co., Thos. H., Phila., Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
General Mfg. Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mach. Tool Co., Cleveland, Ohio.
McGlehan & Co., C. H., New York.
Massey Mach. Co., Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mueller Mach. Tool Co., Cin., O.
National-Acme Mfg. Co., Cleveland, O.
Nutter, Barnes & Co., Boston, Mass.
Poole Co., J. Morton, Wilmington, Del.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Engineering Works, Ellwood City, Ind.
Three Rivers Tool Co., Three Rivers, Mich.

Spools, Steel
Standard Welding Co., Cleve., O.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Link-Belt Engineering Co., Philadelphia, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Whitney Mfg. Co., Hartford, Ct.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Lockwood, Arthur J., New York.
McInnes Steel Co., Corry, Pa.

The Water Hoist of the Lackawanna Company.

It will be recalled that one of the things seen by the members of the American Society of Mechanical Engineers who attended the meeting at Scranton last spring was a mammoth water hoist which had then recently been put in operation at one of the mines of the Lackawanna company and was seen to possess many points

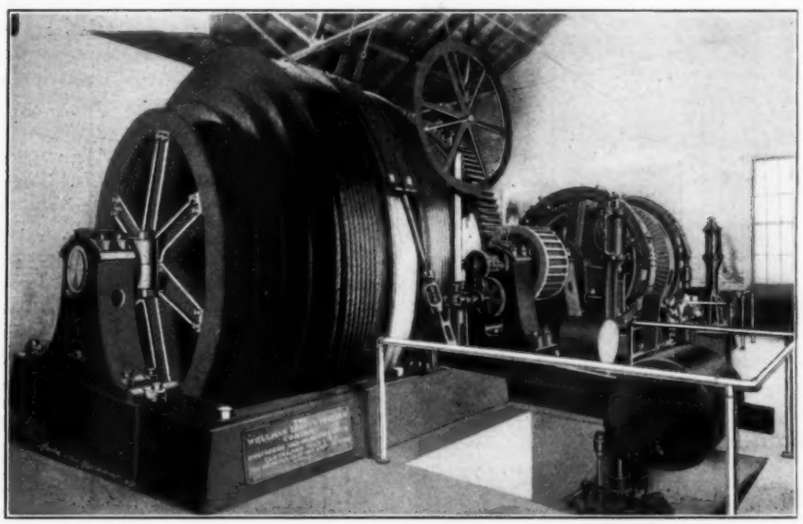


FIG. 1. ELECTRIC HOIST MECHANISM FOR WATER HOIST.

of interest. We are now enabled to present some engravings and a description of the plant.

The matter of unwatering a mine often is a serious problem to the mine management, especially when the water is highly impregnated with acids. When the amount of water becomes excessive the means to be employed for disposing of it taxes the ingenuity of all concerned to the uttermost.

In the anthracite regions there are mines in which, for every ton of coal raised, as high as 14 tons of water must be pumped and this is of course sought to be done at the lowest possible cost. Nowhere, probably, has a greater variety of pumps and lifting devices been tried—and a satisfactory type for handling large quantities of water at comparatively low heads has proved to be large bailers driven by steam engines. These, however, lack the mechanical regularity inherent in a pump, as they are necessarily operated by men, and it remained for the Delaware, Lackawanna & Western Railroad Company and its electrical engineer, H. M. Warren, to finally develop a water-hoisting equipment which would preserve all the valuable points of the steam hoist and at the same time operate automatically. The carrying out of the mechanical details of the hoist and its automatic devices was confided to the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, who guaranteed the machinery to accomplish the desired results. Most of the electrical controlling devices were furnished by the Electric Controller & Supply Company, of Cleveland, Ohio. In the original specifications the D., L. & W. R. R. Co. called for the hoist to be operated by an alternating-current motor of 800 horse-power and the question of starting, stopping and reversing so large a motor had, at the outset, to be met. The duty to be performed by the hoist called for the raising of 4,000 gallons of water per minute to a height of 550 feet.

	Pounds.
4,000 gallons × 8.27.....	= 33,180
550 feet of 2-inch rope × 6.3 =	3,465
To be raised at 550′ per min.,	36,645

$$\frac{36{,}645 \times 550}{33{,}000} = 610 \text{ net horse-power.}$$

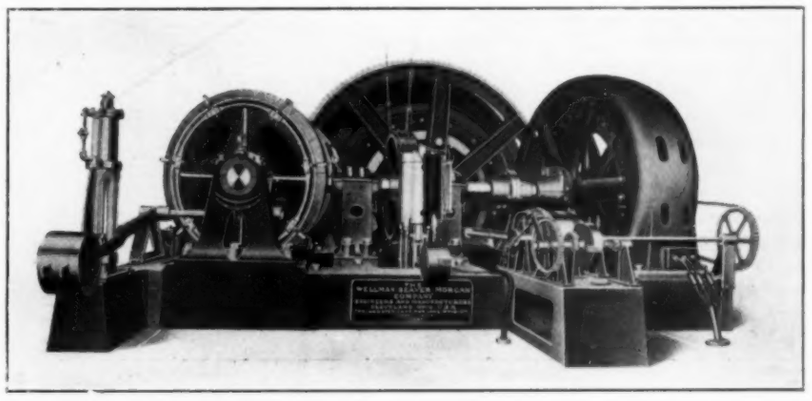


FIG. 2. ELECTRIC HOIST MECHANISM FOR WATER HOIST.

The weight of the bucket equals half the weight of the water, so that the weight on the rope equals 53,235 pounds, or nearly 27 tons; requiring 2-inch steel rope.

The various preliminary speed and movement diagrams were laid out per accompanying diagram. It was decided that it would be impracticable to design the hoist otherwise than have a motor running continuously in one direction, as it is a well-known fact that the amount of current required to accelerate a large motor of this type is enormous, and greatly interferes with the proper running of the power plant.

The D., L. & W. R. R. Co. desired to use an alternating-current motor directly at the hoist, and as the motor was to run continuously in one direction, this necessitated the use of friction clutches for accelerating and reversing the load.

As the Wellman-Seaver-Morgan Company had several smaller plants already in operation using alternating-current motors on hoists which are operated similarly to the present hoist, and as they were running successfully, and the repairs and renewals for clutches had not exceeded those required for the other hoisting engines, it was decided to use this method.

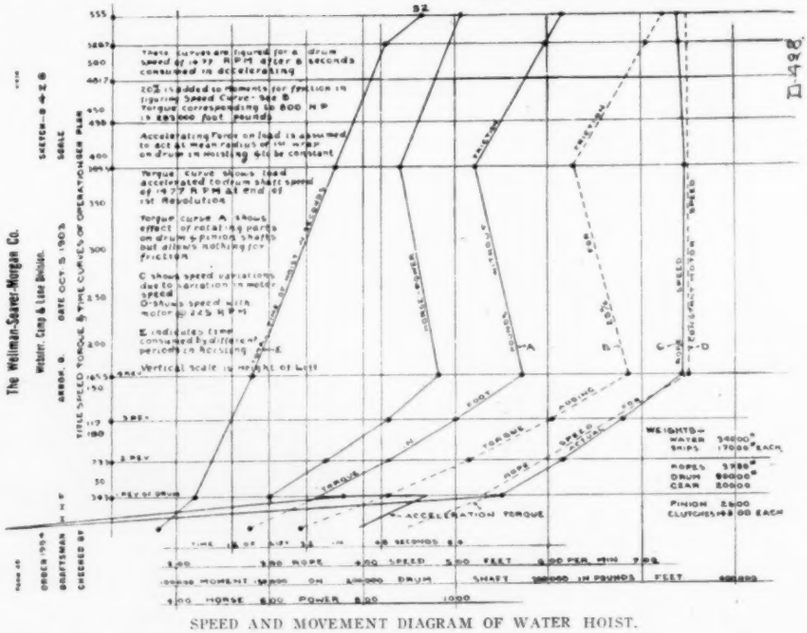
Figs. 1 and 2 show a front and side view of the hoist. As will be noticed, the general arrangement consists of a motor driving a pair of bevel wheels through a single bevel pinion. The bevel wheels run loose on a shaft and are fitted with the well-known Webster, Camp & Lane friction clutches. The operating mechanism for the clutches is so designed that only one clutch can be thrown in at a time, but both clutches can be out at the same time. Throwing in one clutch runs the drum in one direction; throwing in the other reverses the motion of the drum.

To the shaft on which the bevel wheels run there is keyed a pinion meshing with the main gear on the drum shaft. The drums are of the cylindro-conical type, 10 feet at the smaller diameter and 16 feet at the larger diameter. At a hoisting speed of 550 feet per minute the drum makes about 15 revolutions per minute. There is one main brake located between the drums. All of the clutches and brakes are operated by auxiliary air cylinders fitted with oil cushion cylinders, the compressed air being furnished by a motor-driven air compressor and the necessary tanks located near the hoist. The hoist is controlled by a mechanical device shown

in Fig. 2. This device consists mainly of a drum rotated by means of a friction drive from the motor through a sprocket chain. The drum shaft transmits its motion to a secondary shaft fitted with variable speed, which in turn operates a secondary stop. The main hoisting drum shaft operates a traveling nut which is so located with respect to the controller drum that at either end of its travel it releases a stop and allows the controller drum to make a quarter turn; this movement, through suitable electrical connections, operates the solenoids on the clutch valve, releasing the clutch and the solenoid on the brake valve sets the brake, the further movement of the controlling drum being arrested by the secondary stop. This stop is released by the variable-speed shaft and its connections, which has been given a predetermined time movement corresponding to the interval for emptying the bucket. The further movement of the controlling drum releases the brake and throws in the reversing clutch, thus starting the hoist in the opposite direction, and also starting the traveling nut on the controlling mechanism in the opposite direction. At the end of the hoist the cycle of controlling movements is repeated and so on, making the hoisting operation continuous and automatic. Every attention has been given to the safe operation of the hoist. The main brake is of the gravity type, and to be released the current must be on the solenoid operating the valve so that air can be admitted to the under side of the brake piston.

If for any reason either the supply of current or of air pressure is interrupted, the valve drops, and the weights on the brake lever set the brake. The clutches are designed so that they are thrown out by weights. As is the case with the brake, either clutch can be thrown in only when the current is on the solenoid, and the air pressure admitted under the piston, and if either current or pressure fail, the clutch is off. The motor shaft is fitted with an emergency brake operated by a weight controlled by a solenoid—any interruption in the flow of current to the motor sets the brake and stops the motor. Any interruption of the flow of the current stops the machine, throws out the clutches and puts on the brake. A safety cut-out is provided for in the head frame, so that in case a bucket is carried beyond the proper height the current is cut off. Fig. 3 shows the head frame; it is 93 feet from the base to the center of the sheave at the top. It is built of structural steel, roughly in the shape of an "A." From the head frame are suspended two buckets 6 feet in diameter and 19 feet 6 inches deep. The capacity of each bucket is 17 tons of water. In the bottom of the bucket are located two lift gates with an area practically equal to the cross-section of the bucket. These gates are lifted automatically when the bucket reaches the top, and the water is discharged through the bottom into a spout fitted below the bucket, and which deflects it to either side of the shaft. Each bucket makes a complete round-trip in 1 minute and 50 seconds, the total lift being 555 feet.

FIG. 3. HEAD FRAME OF WATER HOIST.



SPEED AND MOVEMENT DIAGRAM OF WATER HOIST.

Testing Powdered Coal For Locomotives.

The New York Central & Hudson River Railroad is conducting experiments at its shops in West Albany with a new method of firing locomotives. The coal is ground into powder and is then, by means of compressed air, blown into the firebox and is consumed so completely that there is practically no smoke or refuse.

The railways of Switzerland, which are all owned and operated by the Federal government, with the exception of the St. Gotthard line, are likely to be altered to electric traction. According to *The Times*, of London, of October 18, a national commission has in preparation plans for the acquirement by the Government of the water-powers most available to furnish the current for railway traction. In a recent discussion in the Federal Council, however, it was stated that no system for the electric operation had yet been decided upon, and the change to electricity will probably not be made for several years to come.

The New Works at the Ingersoll-Rand Drill Company at Phillipsburg, N. J.—V.

THE OFFICE BUILDING.

The office building of the works at Phillipsburg was far from completion internally when the first of this series of articles appeared, so that we could not have begun our description with it, however desirable and proper it might have been to have done so. In the interim the consolidation of the Ingersoll-Sergeant and the Rand companies has been effected, and we have changed the title of the present article to correspond. The office building is now fully occupied and operative in all its functions, and the drawings and photographs here reproduced render it unnecessary to say much in the way of explanation.

The main building, Fig. 54, of brick on the outside, measures over all, approximately, 124x60 feet, with at the rear a safety storage "vault," built *out* of it instead of *into* it, which measures 30x14 feet inside, with apartments corresponding to the several stories and with regular office safe doors and combination locks at each story. Figs. 55, 56 and 57 are, respectively, front, end and rear elevations of the building, requiring no explanation. The sawtooth roofs of the drawing room are mostly hidden by the high coping around the building.

Fig. 58 is a plan of the basement and foundations of the building, and Fig. 59 shows sections of the end walls. The front of the building, it will be remembered, faces the west. The vault spoken of will be noticed projecting from the east side or rear of the building. This portion is entirely without windows, except one each, with heavy iron shutters at the rear of the main and the second story compartments. The area of this storage vault is so large that it is regarded as the normal, and not the emergency, place of deposit for all that it is desirable to preserve. Every tracing belonging to the drawing room is always in its proper drawer here when not in use, as are also all books, cards and papers not immediately required in the business departments. The valuables here stored of course offer little inducement to the burglar, but the destruction of them by fire would be a disaster of the greatest magnitude, and every precaution has been taken against such a catastrophe.

FIG. 55. FRONT OF OFFICE BUILDING.

Cement Coping
Cement Coping
Dark Red Brick Laid in Red Mortar
Four Courses Dark Red Brick Laid in Red Mortar
Dark Brick Laid in Red Mortar
Cement Coping
Dark Brick Laid in Red Mortar
American Machinist

FIG. 56. END OF OFFICE BUILDING.

FIG. 54. OFFICE BUILDING OF THE PHILLIPSBURG WORKS.

The light and roomy and absolutely clean basement of the building will, it is to be presumed, develop its uses later, although there is already a portion of it appropriated to the storage of the material and appurtenances of the culinary department; a laundry also is provided for and large toilet accommodations. A space here nearly corresponding to that of the drawing room in the second story seems to be as yet unappropriated. If a reading room or library, or a meeting room for the men should ever become desirable or practicable here would seem to be an excellent place for it. The men, however, live so far from the works that this would seem to be for the present not worth considering. Building lots near the works are being taken up, houses are being built and the entire surroundings of the works will soon be very much changed, just as Easton was ultimately so changed by the

location of the works there a dozen years ago.

The main story of the building comprises the business offices of the works, the business here transacted having to do entirely with the operating of the works and the turning out of the product, and not at all with the sales and general business negotiations, these being carried on in the extensive offices of the company in the Bowling Green building, New York city. Fig. 60 is a plan of the offices. The half-tone, Fig. 61, is the view upon stepping in from the vestibule. A wide corridor runs right and left, north and south, from here, that at the right turning to the east for the stairway and the rear entrance. The office of the general manager, Geo. R. Elder, is at the left and front, occupying the northwest portion, while the auditing and accounting department, with that of the cashier and paymaster, occupy the west and entire south portions, and the purchasing and order department the north and east. Fig. 62 gives an excellent view of a large portion of the purchasing department, but Fig. 63 of the accounting department is quite unsatisfactory. This view, necessarily taken within the room, from the southwest corner, shows only the least interesting portion of it, the partitioned portion for the cashier at the southeast corner not appearing at all. The cashier has a separate double entrance which might be used by the men when paying off, but is not so used, as the envelopes are carried around to the men on Friday afternoons.

Fig. 64 is a plan of the second story, which is given up entirely to the drawing and engineering department, the choicest corner, the southwest, being retained as a private room for Mr. Sergeant. The view

FIG. 57. REAR OF OFFICE BUILDING, SHOWING VAULT.

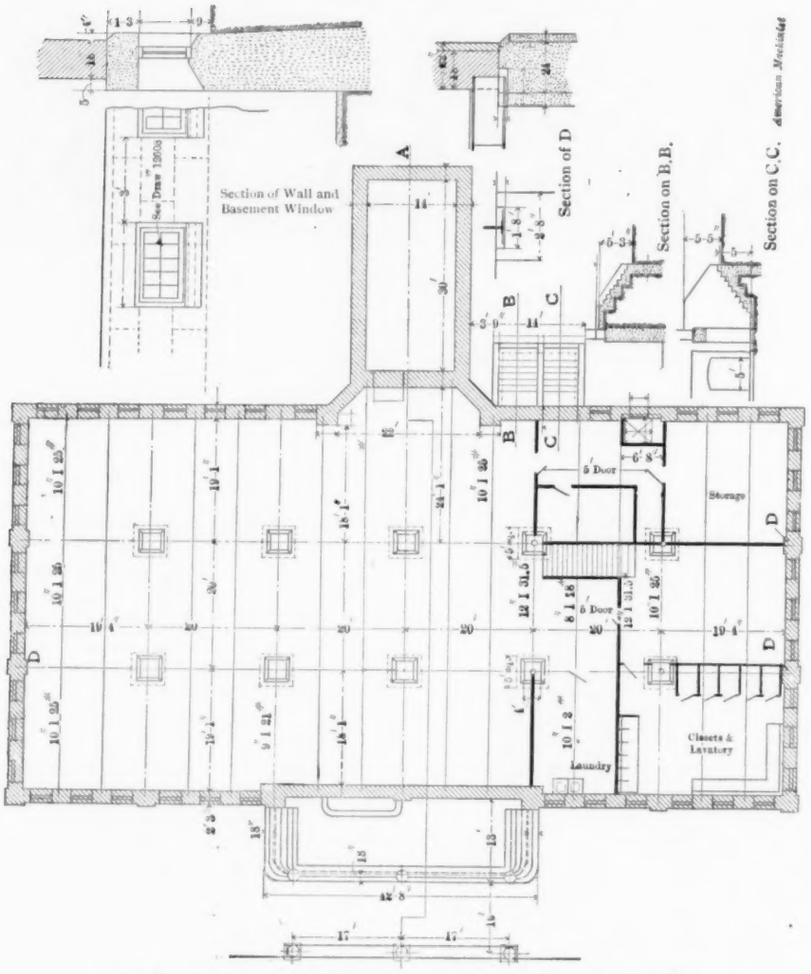


FIG. 58. PLAN OF BASEMENT AND FOUNDATIONS OF OFFICE BUILDING.

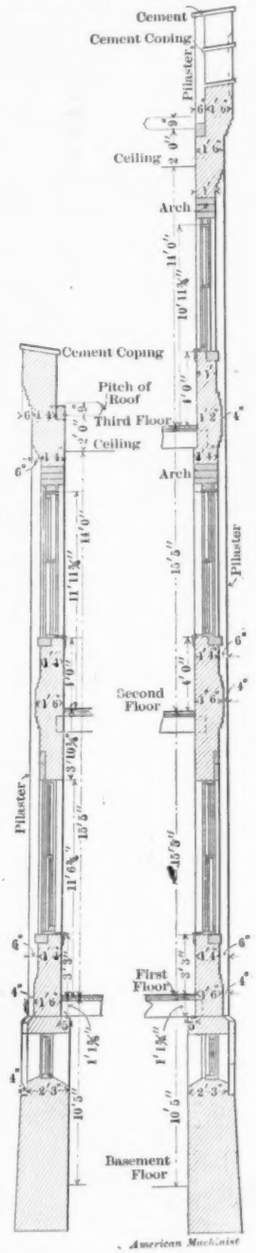


FIG. 59. SECTIONS OF END WALL.

of the drawing-room in the half-tone, Fig. 65, gives a good idea of its light and roomy character, although only about two-thirds of the length of it is shown. The room of Mr. Prellwitz, chief engineer, is at the right-hand rear corner of this view, Mr. Sergeant's room being beyond it. The vault door, at the left rear, is not distinguishable. The blueprint-room is beyond the partition, being, of course, in the south end of this story. Against the wall at the left is the cabinet for paper. There is a good valve motion and also other appliances which do not come into this view.

The third story, which is only at the south end of the building and does not interfere with the saw-tooth roof of the drawing-room, provides an excellent dining-room, with all appurtenances. A plan of this floor is given in Fig. 66, and Fig. 67 shows a part of the dining-room, with the kitchen door open. The kitchen is at the east side or rear of the building, with the elevator opening into it. This elevator is not for general passenger service, but is mostly for the use of the caterer and his staff in conveying material up from the basement or the rear doorway where the supplies are delivered. At present about forty of the office force are served with luncheon daily, with room for two or three times as many.

This office building stands entirely for business, and there is absolutely nothing that is merely decorative about it. The functional adaptation of every detail con-

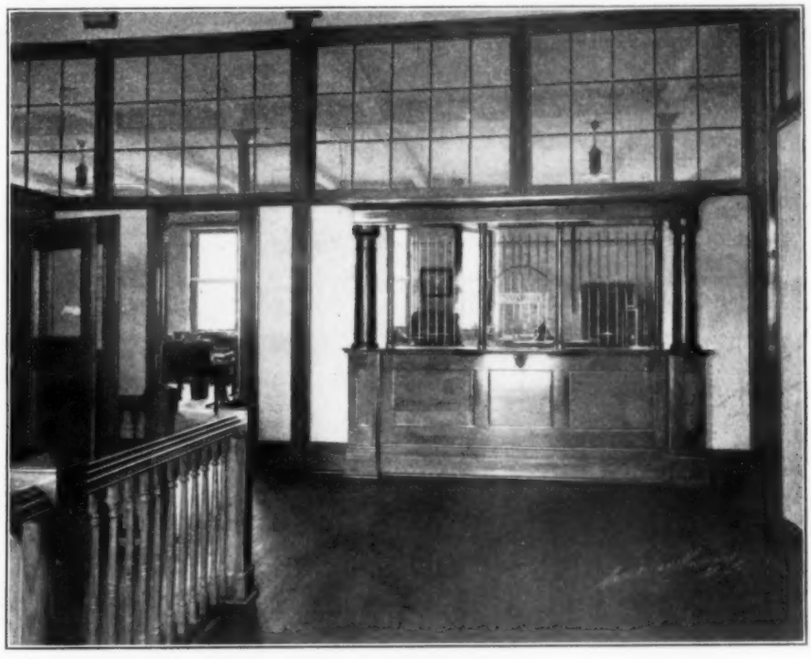


FIG. 61. MAIN ENTRANCE.

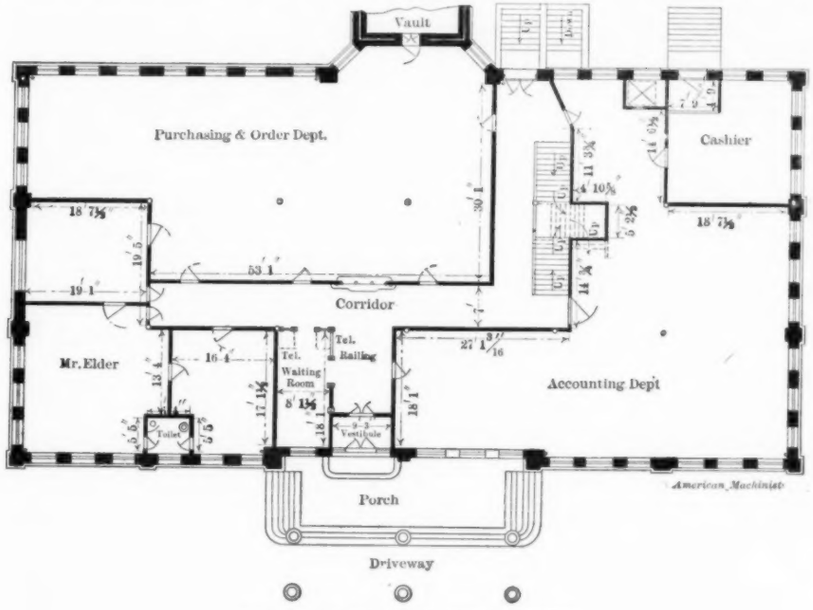


FIG. 60. PLAN OF BUSINESS OFFICES.

stitutes the supreme beauty of a business structure, and this is present throughout. The view as the visitor enters the front door, Fig. 61, makes a good picture, but examined in detail, it suggests no extra-rooms expense to secure the effect. The symmetrical and uniform distribution of the windows, as seen from the outside all around the building, is admirable, but the arrangement provokes criticism when one comes to look out of them. The window sills in each story are from a foot to two feet higher than they should be, so that a person seated, even in the dining room, can see nothing but the sky as he looks out. A look off over the hills, as in Fig. 68, would seem to be restful rather than distracting to a fellow looking up from a drawing-board or from checking a pile of time cards.

The building is of the most absolute fireproof construction throughout, iron columns supporting the floor, which comprise steel I-beams and concrete arches. The construction of the partitions is shown in the half-tone, Fig. 69. The slabs or blocks are composed of a patented fireproof material, and are about 2 inches thick. The binders are of thick sheet steel, bent over in both directions at each end, and these, being placed as the slabs are successively laid up, they hold and are held securely. The little space occupied by the partitions, as thus constructed, appears in the plans which appear in this article. In the design of this building, provision is made, as with all the other buildings, for its enlargement or extension as further developments of business may require. The lighting and heating of the building is done from the general plant, which supplies the entire works. The steps in front of the building, and the pedestals for the columns, are of concrete, this material appearing throughout the construction from the foundations and the basement walls to the coping which surmounts the entire building.

The unoccupied grounds approaching and surrounding the offices are still to be finished, and the work in this direction is progressing. Fig. 70 shows the method followed in making the roadways. The trend of the road in this view is from the upper right-hand to the lower left-hand corner. Instead of excavating, as is customary, for the placing of the large stones to form the base of the road, this material is simply laid upon the surface as originally graded, and after the placing of these stones and the covering of them with the top dressing of cinders, the adjacent surfaces are filled up to this new level. In Fig. 54 the drive to the office has been completed, but the foreground is still to be brought up to the same level as indi-

cated by the manhole at the extreme left. It seems to be safe to say that few plants have ever been erected which have been more carefully and more exhaustively planned in advance of the construction than the admirable works which have been sketched in these articles. There has apparently been a reason for the doing of everything and for the doing of it in the way in which it has been done here. Some of these reasons have been, of course, applicable only to this individual plant and to its special conditions and requirements, but a minute study of the details of it could not fail to be profitable to any who have to do with the planning and the building of industrial works. R.

FIG. 62. THE PURCHASING DEPARTMENT.

No more interesting work is under way in Chicago at the present time than that on the elaborate system of freight tunnels underlying the central business district of the city. In a business sense the project has had a checkered career, but, technically considered, the work is of increasing interest.

In a nutshell the idea is to convey coal, ashes, earth from building excavations, freight, merchandise and mail matter in an elaborate system of tunnels underneath the central business or "downtown" portion of Chicago by means of narrow-gage (24 inches) electric railways. On October 21, 1905, there had been completed 205,181 feet, or nearly 39 miles, of these tunnels, horseshoe-shaped and built of concrete in the most substantial fashion. At the same date twenty-seven building connections had been made, in some cases by elevator shafts with basements, in others by direct lateral tunnel connections to unusually deep sub-basements. As yet, the tunnels are in use only to a limited extent, transporting excavated earth from building sites, ashes from office-building basements, mail and a little coal. But when their full carrying capacity is utilized they will relieve the congested streets above of a great deal of teaming, connecting, as they do, with all the great railroad terminals, and will work a decided and unique improvement in city life.—*Western Electrician.*

From an inspection of the designs for the support and protection of the third rail to be used respectively by the New York Central and the Pennsylvania Railroads on their electrified lines in the vicinity of New York city, it is evident that the effort to standardize the location of these rails has been abandoned. The lateral distance from the gage line of the track rail to the center of the conductor rail is 29 inches for the New York Central and 27½ inches for the Pennsylvania's Long Island line. The vertical distance from the top of the track rail to the central surface of the conductor is 2¾ inches on the former line, and 3½ inches on the latter. Apart from these wide differences of location the designs for the protection of the third rails on the two lines are radically different. The New York Central rail is suspended from a high gray-iron goose-neck bracket and the contact is on the lower surface of a bull-head rail, while the design for the Long Island rail shows a short column, with a T-rail directly above it, and the contact is necessarily on the upper surface.—*Railway Age.*

According to a German paper, the German cruiser "Wacht" is to be equipped with steam turbines, and will be constructed by a private firm of shipbuilders.

Echoes From the Oil Country—A Foundry Mystery.

There are so many ways that a mold may be defective that it is not always easy to say which of the ways is the one that is responsible for any unnecessary roughness that may appear on a casting. This is especially true in a foundry that is doing all sorts of jobbing and often using old castings for patterns. With such patterns the sand will generally tear out more or less and so a lot of patching has to be done to the mold. When much patching is necessary it is hardly to be expected that the casting will be as smooth as it would be if a good pattern were used, but even with a poor casting as a pattern there are limits to the amount of allowable variation and in some of the castings that were coming out of this little jobbing foundry it did seem as though the limit had been reached if not actually passed.

After a casting has been shaken out it is not always the easiest thing in the world to be sure why certain undesired bumps or hollows are on it, and when they happen to be of an unfamiliar kind the uncertainties of the case are increased.

The kind of marks that had begun to make life miserable were beyond the knowledge of even the boss molder, and the boys thought he knew everything even if the two molders did not.

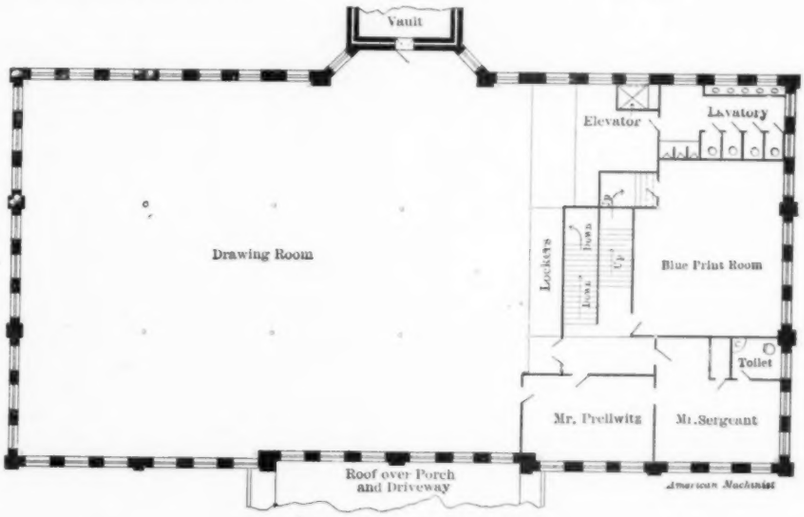


FIG. 64. PLAN OF SECOND STORY.

They showed up first in Harry's casting, and Harry was given credit for having discovered a new way of making a bad casting, although it was a mystery to him how he did it. Then it was Tom's casting that came bad, and as Tom was a careful boy the men said he must have caught the disease from Harry.

These defects are rather hard to describe. Sometimes the casting would be an almost shapeless mass, and sometimes it would only have an extra ridge some-

FIG. 63. IN THE ACCOUNTING, AUDITING AND CASHIER'S DEPARTMENT.

where. These ridges seemed to come in almost any part of the mold and to be almost any shape. The only thing they had in common was that they were never smooth. Sometimes they were nothing more than a roughening of the surface and sometimes they were deep.

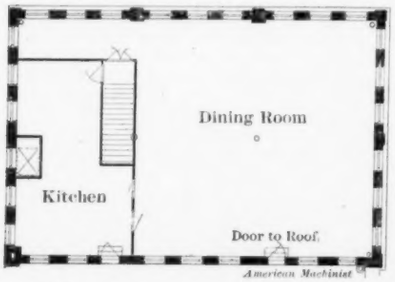


FIG. 66. PLAN OF KITCHEN AND DINING-ROOM.

At first it was only once in a while that a casting would show up marked in this way, and it so happened that those that did were made by the boys, but presently an important casting made by one of the men was worse than anything that had yet turned up, and the matter began to look serious.

As the foundry was small, it took several days at times to get up a heat. At this time they were casting twice a week. One morning one of the molders noticed that the side of a gate on a mold that

FIG. 67. THE DINING-ROOM.

FIG. 65. THE DRAWING-ROOM.

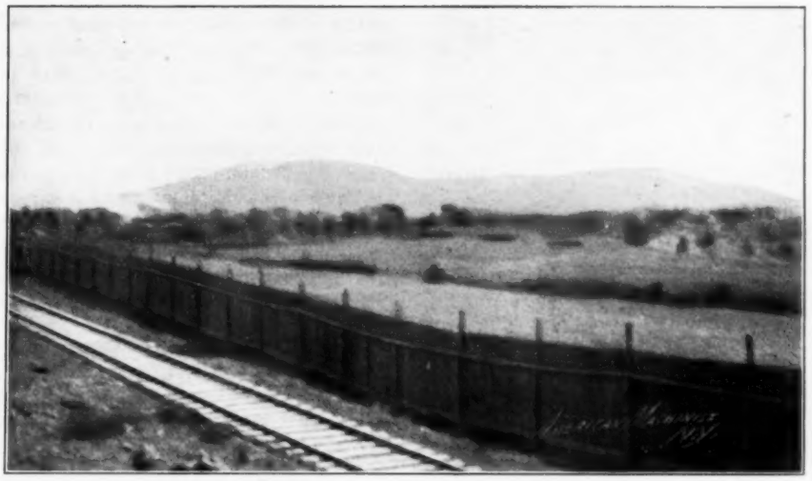


FIG. 68. THE OFFICE OUTLOOK.

had been standing over night was damaged in some way. It did not look as if it had been struck with anything but more as if something had been dragged over the edge at one side. Fearing that some sand might have dropped down where it would do damage he lifted the cope off and the inside was a sight to behold. It was ruined beyond repair, and from evidence left behind it was plainly to be seen that it was the work of rats. An examination of all of the molds on the floor showed that most of them had been entered by the rats, although there was only one other that showed any evidence of it on the outside. In some of them the damage done was so slight that it would hardly have been noticed on the castings, while in others the entire inside of the mold was destroyed. As one of the boys remarked, "they must have either been fighting in here or else playing football."

Of course rats are not uncommon in most foundries, but the situation of this one was such that while they were apt to be more plentiful than ordinary they did not need to come there for food. There was a grist-mill next door and there was lots to eat there and in great variety, and besides that it is hard to see what they would find to eat in the molds. Generally the castings requiring much core work were left to the last to save the trouble of closing and then opening up again on the day of the cast to set the cores, for on most work they did not like to let the cores set in the molds over night. There were other things that seemed to indicate that it was not food that they were after. The cores that were made up were not disturbed, and molds that were left open were not interfered with, and outside of the flour and molasses used in the cores it is hard to see anything that even a hungry rat would want to eat.

It became the custom after that to securely cover all the gate and riser holes, and that stopped the trouble.

W. OSBORNE.

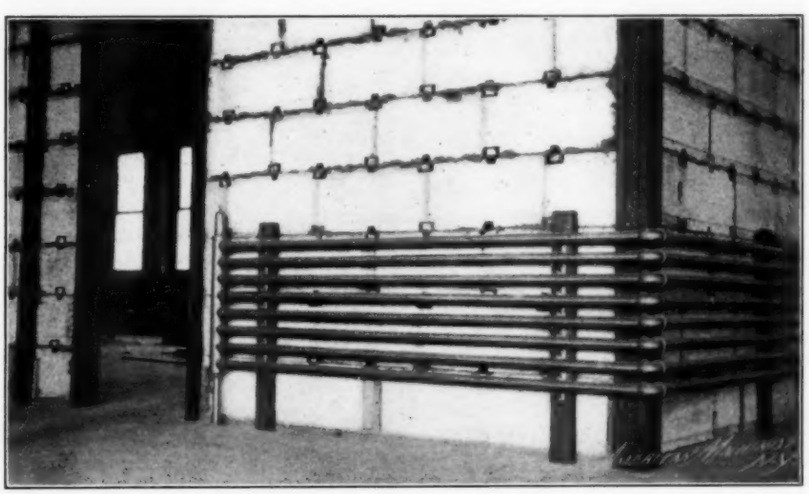


FIG. 69. FIREPROOF PARTITIONS.

An article in the *Motor Trader* (London) discusses the future of the automobile business, expressing the opinion that the United States is at present the greatest market, and that, in the rapid extension of the employment of motor-cars and the springing up of new factories, the conditions are similar to the cycle boom of ten years ago, the hope being, however, expressed that this boom will not have the same ending. The writer forecasts the probability of the American output developing beyond the absorbing capacity of the American market, and states: "With France forced to create a market in high-priced cars, and America in the lower strata, and both producing at cheaper cost than ourselves, it is not difficult to see the components of a situation that will plunge the motor manufacturers of this country (England) into distress. . . . The chief, indeed the only real, safeguard is to ceaselessly seek to reduce cost of production. When the British cycle manufacturer, by adopting labor-saving machinery and tools, was able to meet his foreign competitor in cost, foreign competition on his market melted away like an October morning mist before the sun. History will probably repeat itself."

FIG. 70. MAKING THE ROADWAY.

54-Inch Rapid Production Boring and Turning Mill.

The accompanying half-tones illustrate the latest product of the Bullard Machine Tool Company, of Bridgeport, Conn. While called a 54-inch mill, its actual swing is 56 inches. The extreme distance between table and cross-rail is 42 inches.

OPERATING MECHANISM.

A leading feature in the design is what the makers call the automobile principle, by which is meant the placing of the various operating levers in such locations that they may be reached from a single position of the operator and, except for the feed works of the left-hand head, this is strictly carried out. The machine is of the single belt speed and gear-box construction, the speeds being obtained by a set of gears and friction clutches enclosed in the speed box in the right background of Fig. 1, in combination with three sets of back gears, all of which, together with the brake, are controlled by the pilot wheel and lever immediately behind it, as shown in Fig. 1 and to larger scale in Fig. 2. These movements are all interlocked to make conflict between them impossible. The pilot wheel *A* operates the friction clutches by turning, and it applies the brake by lifting the handle *B*. The brake can be applied only when the frictions are disengaged and it is rendered impossible to turn the pilot wheel while the brake is on. Similarly, the lever *C*, controlling the changes in reduction gearing cannot be operated except when the brake is set, and it, in turn, locks the brake-lever until a gear is fully engaged. While completely performing its function of safeguarding the driving mechanism from careless handling, this interlocking device in no way interferes with the rapid operation of the machine; a change from the highest to the lowest speed being made in a very few seconds.

SPEED GEAR AND LUBRICATION.

The speeds, of which there are fifteen, are in geometrical progression, and in the driving train of gearing there is no step-up motion; the first-motion shaft running the fastest of all, with a continuous drop between it and the table. The back gears are enclosed in a box, and in use the box acts as an oil well, the gears being flooded with oil, and the same is true of the gears and friction clutches in the speed box. These clutches have been tested under the condition of flooded lubrication and found capable of transmitting 30 horse-power. They are of a type which takes up its own wear. All bearings of the main driving train have oil cellars and ring or chain oilers. The lubrication of the table bearing is equally effective, as shown in Fig. 3. An external oil tell-tale is provided, and the oil is carried at a point which floods the angular thrust bearing, while a ring of felt carries the oil to the spindle bearing.

FEED AND TRAVERSE.

The feed is of the positive gear box type, giving ten changes, from 1-64 to ¾ inch in all directions, which are obtained by manipulating two levers *D* and *E*, Fig. 2. Rapid traverse of the head on the rail and of the bar in the head are obtained from the same vertical shaft as the feed, the manipulation being by the lever *F* at the bottom of the shaft. In the mid position of this lever the gear feed is engaged; by lifting the lever the feed is disengaged and the rapid upward traverse is thrown in, and by depressing the lever the feed is disengaged and the rapid downward traverse is engaged—conflict between the feed and traverse being thus impossible. The reversal of the feed is by the vertical bent lever *G*. Located here, it does not affect the rapid-traverse lever, the movments of which upward or downward have thus a fixed meaning under all circumstances.

The engaging of the feed is by a positive claw clutch, which is so made that it has but one engaging position. The object of this is to permit the use of the quick traverse for the return movement when cutting threads, in which use it makes the splitting of threads impossible. The screw-cutting feature is an extra, not shown in the illustrations. It is mounted on the end of the cross-rail without change of or interference with the feed mechanism. By its use, combined with special gearing, angular facing may be done.

The rapid traverse is obtained from the bevel friction wheels at the top of the housings. It is intended to be used to the exclusion of hand-cranking and it will be noticed that there are no hand-cranks about the machine. When adjusting the tool-heads or bars for the cut it is intended that they shall be run rapidly to nearly the desired point by the traverse motion, the final adjustment being by the hand-levers *H*. These levers operate by a double automatically acting ratchet which adjusts the tool with great precision. The usefulness of the rapid traverse to the exclusion of hand-cranking is increased by the fact that there are no pull gears on the end of the rail to change from the horizontal to the vertical motion and *vice versa*, this function being obtained by the horizontal lever *I*. The action of this lever is through a friction, which will slip and save breakage of gears in case the feed is allowed to continue too far.

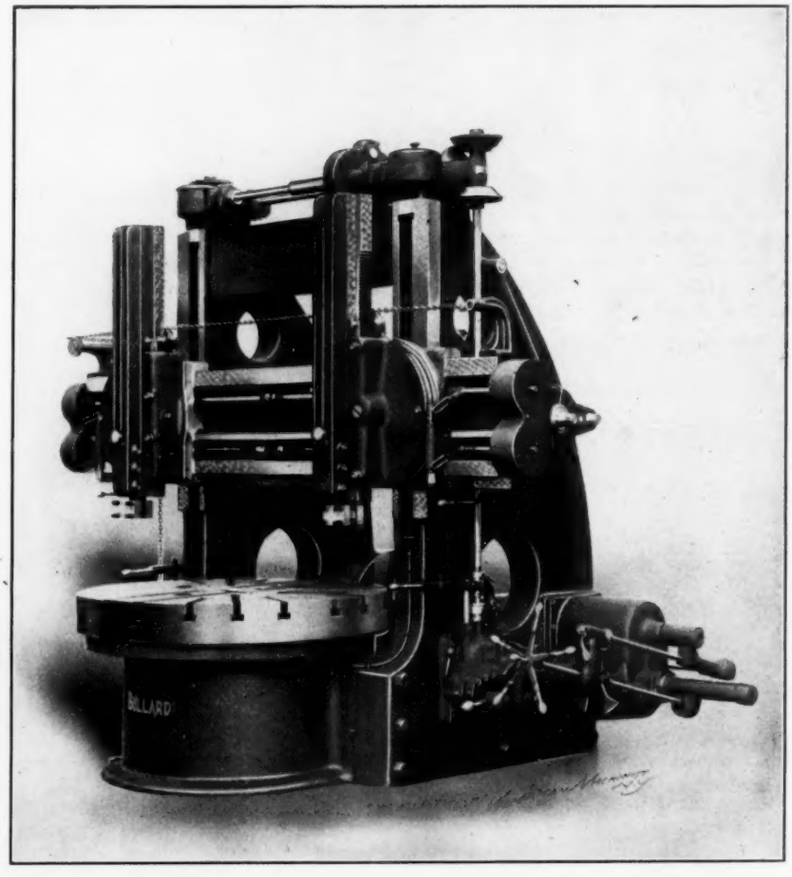


FIG. 1. FIFTY-FOUR INCH RAPID PRODUCTION BORING AND TURNING MILL.

TOOL-HEADS AND CROSS-RAIL.

The vertical support of the tool-heads will be seen to be by the lower edge of the cross-rail, the guide at the top preventing tipping forward only. This feature is original with the Bullard Company,

having been first applied to their 10-foot mill described at page 772, Vol. 26. It is so obviously correct and has been so satisfactory in use that the same principle is in this machine applied to the guiding of the cross-rail, which is positively fitted endwise of itself to the right-hand housing only. The great length of a cross-rail compared with its comparatively small depth makes the "bureau drawer" action very pronounced on this member, and with the present plan of guiding this is entirely eliminated, although the guides are a positive fit in the housing.

The weight of the heads being carried by the lower edge of the rail, it is obviously correct that the feed-screws should be located near the guides, and this construction, it will be observed, has been followed. Neither head is ever required to pass beyond the center of the rail, and hence, by driving each screw from its own end of the rail, it may be made of half the length of the rail and the two be placed in line, as is done. The stops for locating the heads at the center of the table act on the nuts—not on the bodies of the heads—thus avoiding any canting action. The step collars of the screws are at their inner ends, making the usual strain upon them one of tension.

FIG. 3. STEP AND SPINDLE BEARING, SHOWING METHOD OF LUBRICATION.

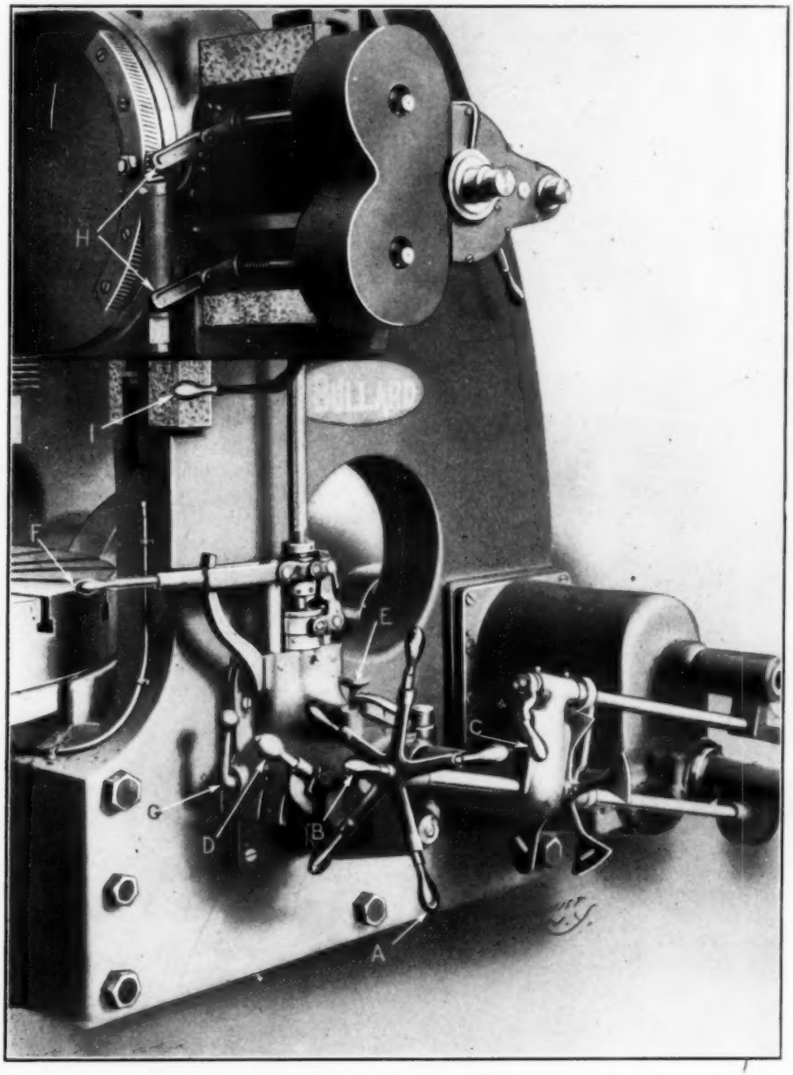


FIG. 2. ENLARGED VIEW OF OPERATING MECHANISM.

While the cross-rail screws are located as low as possible, the splined rods for the vertical feeds are as high as possible. The object of this is to get the pinion which drives the tool-bar as high up as possible, and, in combination with a tool-holder smaller than its guides, this permits the tool-holder to be withdrawn well within the guides as shown in Fig. 4. This in turn permits the rail to be placed low down when boring a pulley hub, for example, and it also permits a piece of work to be handled whose weight is the extreme distance between the rail and the table, there being no reduction of this distance by a projecting tool-holder.

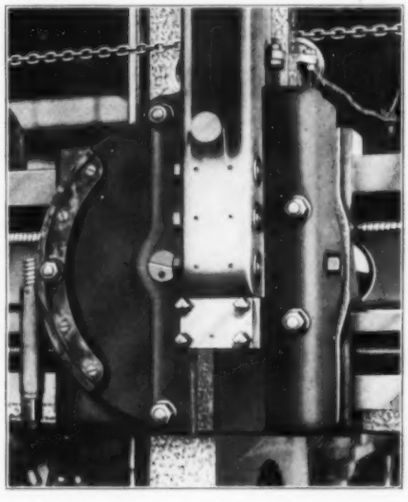


FIG. 4. TOOL-HOLDER WITHDRAWN WITHIN GUIDES.

Another feature which deserves notice is the method of driving the cross-rail lifting shaft, which is driven by a tumble gear, the last pinion of which is formed on the end of a quill, through which the shaft passes. The quill is supported by its shaft, on which it is a running fit, but its length is such as to reach the center of the shaft where the driving key is located. The driving of the shaft being thus from its center, the torsion of its two ends is equalized.

The drive of the machine being by a constant-speed belt, it is applicable without change to a contant-speed motor drive, for which the motor is mounted on a shelf bolted between the housings, as shown in Fig. 5. The location of the shelf is such that by placing the motor above it the connection to the machine is by a belt, and by inverting the shelf and motor the latter is brought to the correct position for a gear connection.

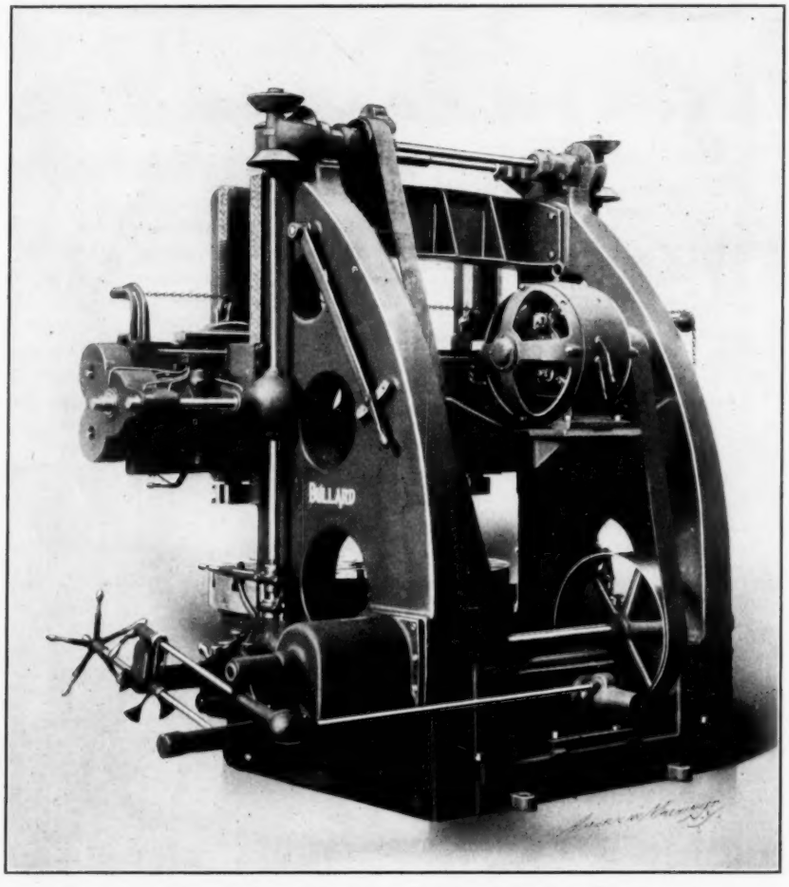


FIG. 5. MILL ARRANGED FOR MOTOR DRIVING WITH BELT CONNECTION.

It will be observed that there are no exposed gears about the machine.

In Germany motor cars all have a dial which is like a French taxameter. When a speed of 15 kilometers is passed, a white rectangle is displayed, when 25 kilometers is passed a red rectangle, and so on. This system has the advantage of warning the police automatically, and at the same time of protecting the chauffeur. Another system is that of the chronotaximeter, as used on locomotives. This instrument is sealed by the authorities, and can be examined at long intervals, say at the end of every three months, when all speeds traveled in the meantime will be found recorded.

The most usual solders are the compound, which are distinguished into two principal classes, the hard and soft solders. Hard solders are ductile and will stand hammering, and are ordinarily prepared of the same metal as that which is to be soldered, with the addition of some other, by which a greater degree of fusibility is obtained, though the addition is not always required to be itself easier of fusion. Under this head comes the hard solder for gold, which is prepared from equal parts of gold and silver, or gold and copper, or gold, silver and copper. The hard solder for silver is prepared from equal parts of silver and brass, but is made better for fusion by the addition of 1-16 part of zinc. The hard solder for brass is obtained from brass mixed with a sixth or an eighth of zinc, and this will also make a hard solder for copper. A good soft solder is tin and lead in equal quantity. Of easier fusion is a solder of bismuth, tin and lead in equal parts.—*The Lead and Zinc News.*

Recent Improvements in the Newall Measuring Machine.

We have, from time to time, published accounts of the improvements in gages and measuring machines brought out by the Newall Engineering Company, of Atherton's Quay, Warrington, England, and in particular we gave at page 964, Vol. 26, a detailed description of their measuring machine, including the sensitive level tailstock for establishing the zero and insuring uniform pressure of contact, and the exceedingly neat arrangement of vernier for reading the measurements. The sensitive level, which multiplies the movement of the anvil by 4,000, has been found to be completely satisfactory—so much so in fact, as to necessitate the redesign of the headstock in order to bring it to an equal state of perfection.

A large degree of interest in these appliances has developed among British manufacturers, especially among shipbuilders, and calls are being made for larger and larger sizes of machines. When our last article appeared the largest size made had a capacity of 4 feet, while the machine shown in Fig. 1 has a capacity of 6 feet, and several inquiries have been received for machines having capacities up to 12 feet.

The new headstock is shown in Fig. 2, from which it will be seen that the long screw *a* and nut *b*, with a total travel of 1 inch have been retained, together with the buttress thread, the flat faces of which are the effective faces. The weight of the screwed spindle is now, however, carried at its two ends, thus taking the weight of itself and its fittings from the threaded portion. In order to maintain a constant pressure against the flat faces of the thread a short nut *c* and spring *d* have been added. The short nut is a sliding fit in the recess which holds it, and it is kept from turning by a feather. The pressure of the spring thrusting against the nut keeps the flat faces of the screw and nut threads under constant and uniform pressure. It will be observed that the nut *c* acts again the angular faces of the threads of the spindle, and hence it introduces no local wear on the effective faces. As thus made the machine is so delicate that, using machine oil as a lubricant, the presence of a film of oil in the threads will show itself in the readings. To obviate this paraffin is used as a lubricant.

The most interesting new feature of the headstock, however, is the method of compensating the error of the screw. The Newall Company has so far perfected the methods of producing these screws that it is able to produce right from the machine screws that will give correct readings with .0002 inch. This error is sometimes in one direction and sometimes in the other and hence is due to uncontrollable elements and not to errors in the lead-screw. To correct this error lapping was formerly resorted to, but this

is not a satisfactory process, as beyond a certain point it is apt to do more harm than good. Substantially correct readings could be obtained at certain points, such as ¼, ½, ¾ and 1 inch, but it was found impossible to obtain correct readings at all points. The lapping has therefore been abandoned, and the error-compensating device shown has been adopted.

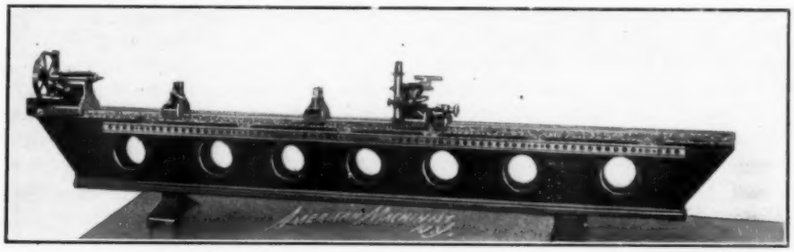


FIG. 1. THE NEWALL 6-FOOT MEASURING MACHINE.

The spindle has cut on its rear end a square thread *e* of the same pitch as the measuring screw, and on the crest of this screw a hardened roller *f*, best shown in the end view, rides. This roller is carried by the lever *g*, which is pivoted at *h*. The upright arm *j*, which carries the vernier *k*, is fitted with a pin and sliding block *l* working in a slot in the lever *g*, the spring *m* maintaining the roller in constant contact with the square thread. It will be seen that by making undulations in the crest of the square thread the lever and vernier will be moved as the screw turns, and if the undulations are suitable the the errors in the screw will be compensated.

The errors in the screw are determined by measuring standards of known accuracy at, say, every 1-16 or 1-32 inch as required; flats are then made on the crest of the square thread which so move the vernier as to make the readings correct at the point where the measurements have been taken. At this stage the square thread has a mass of flats in its crest, and these flats are then sloped toward one another, thus striking an average in the intervening spaces.

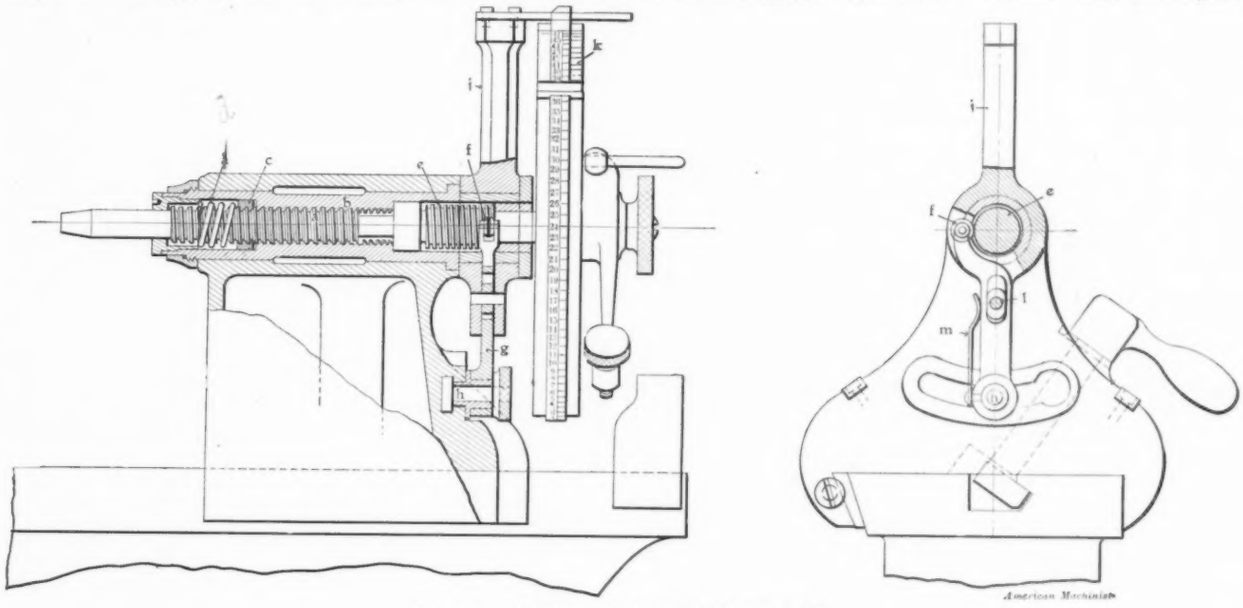


FIG. 2. HEADSTOCK OF MEASURING MACHINE.

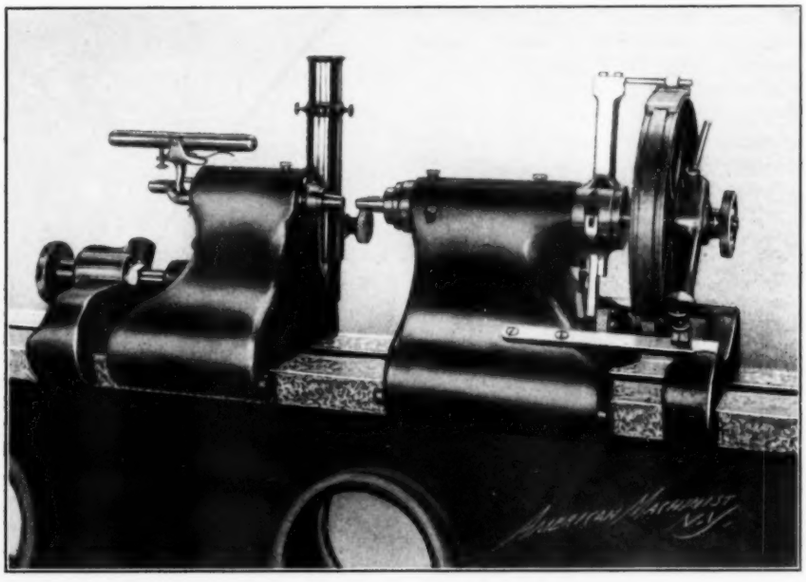


FIG. 3. HEAD AND FOOT STOCKS.

A great feature of the method is the great length of the square thread which is available for making the corrections. In the case of the device employed in the precision lathe at page 619, for example, the length of the correcting bar is equal to that of the lead-screw, whereas, with the present device, that length is the entire circumference of the screw—about 23½ inches for 1 inch of travel. The pitch of the screw is 20 threads per inch and the machine reads to 1-100,000 inch. The Newall Company informs us that it has no difficulty in repeating measurements many times and have the results agree within 1-50,000 inch.

An enlarged perspective view of the headstock and tailstock is given in Fig. 3. It will be observed that the footstock is fitted with a microscope for reading from line measures.

Letters to the Editor.

The Plea For Larger Pulleys—The Limiting Belt-Speed.

At page 219, W. D. Graves makes a plea for larger pulleys, especially on woodworking machines, and the probabilities are very great that, if he had written his request in the form of a petition and circulated it among the woodworking machine operators for signatures, he would have obtained the autographs of such a large per cent. of them that it would have been nearly unanimous.

I was one of the fraternity of woodworkers many years ago, and in fact complained of the sizes of pulleys on the machines in the early 70's, and whenever called into consultation regarding the placing of an order for a new machine I expressed my opinion very forcibly in regard to this question, and in some few instances succeeded in getting changes made and larger pulleys placed on the machine, but as a general thing was informed that it would be impossible to make any change and get the machine in a reasonable time; that the manufacturers had furnished a great many machines—I think Brother Elliott said "'a great many' is rather ambiguous, but it saves a lot of lying"—and they were *all* giving satisfaction; that to make any changes in the sizes of pulleys would require the remodeling of the whole machine. This last statement was self-evident, as it was the rule, rather than the exception, that the operator had to chip and file more or less to get clearance so the belts would run without rubbing against some part of the frame or housings; sure proof that the machine had not been tested under belt.

Becoming interested in a plant manufacturing a variety of articles, where it became absolutely necessary to increase the output much beyond the capacity of the machines then in use, I was positive that some machines built on an entirely different design from any in use or on the market, would help out, and made some sketches to show how I would do it, making the machines to a large extent automatic in some of the operations. It was decided by the management that the idea was feasible, owing to a machinist who was called in for consultation saying he was so sure they would accomplish results that he was willing to build one, and if it was not satisfactory his work would cost nothing. Another case of the outsider having a better appreciation of our brain powers than our immediate associates in the business.

The success of these special machines was such that we were encouraged to try what we could do with some other special work, among others that of getting up a full line of machines for a new department which required something different from anything then on the market, and the satisfactory results with these led to an engagement to design some "new and improved" machines for a company entirely engaged in the manufacture of woodworking machinery. The first year was devoted to small tools and special attachments to be used in connection with their standard line, rather than getting up new machines, there being several reasons for this besides the want of the small tools; among others, that it was very necessary to get acquainted with their methods and particularly with their ability to handle the work on the machine tools they had, so as not to design something they would be unable to manufacture with their then equpipment. This point was most emphatically impressed on the mind of the new designer, and was the cause of the firm being compelled to omit some machines from their list that were often asked for.

After this preliminary study of methods, conveniences and standards (the standards were different from those of any other shop if it was possible to make them so) I was instructed to design a new machine which would be adapted to do the same work as "Butcher's No. 900"; it must be about the same weight, but as much superior as it was possible to make it; in fact, they wanted to have "the very best machine there would be on the market; one so much in advance of anything then being manufactured that it would displace them all."

Now there were some fairly good machines on the market, and it looked as if there would be quite a chance for study and thought either to design new movements or rearrange old ones to even equal those machines, but there was one point I was sure of: we would put on pulleys that would stop all complaints, as all clearance desired could be arranged for, and that alone would put this machine so far in advance of anything else that it would make the reputation of the company such that, combined with their past record for doing their work well, it would enable them to control the market. From my view, as an operator, the pulley sizes were the most important point to look after in the design; as the machinists must do practically perfect work, the bearings must be true, and it was perfectly easy to arrange the various parts. At this time I will not speak of the troubles we had to keep two or more parts from wanting to get in the same place, but will tell about the pulleys.

The first drawings, consisting of a plan and elevation, were but little more than sketches, though drawn to scale, to show general ideas, and were subject to many changes as the details should be worked out; but when they were examined by the "Executive Board," to determine how nearly practical they were and to decide if they should be "worked up," objection was made to the pulleys as shown; they would not do at all. I felt that our reputation depended entirely on this and explained why they were made the various sizes shown. They were 50 per cent. larger than those in general use at that time, for similar work, and I told of the troubles observed in the operation of similar machines, not only those personally operated but others I had seen or heard of, and accused the manufacturers of being afraid the machines would cost a few cents more than they would if built with the smaller pulleys.

One of the "E. B.," a man of many years' experience in building machinery, said: "I think you are right about the troubles, but before we decide that the pulley sizes are right or wrong I wish you would go and see the belt men down town, talk with them, tell them what troubles you have found and what you propose to do, and see if they have any suggestions to make. Be sure to tell them the speeds you are to run these pulleys."

It did not take long to recall a very serious difficulty we had some time before, where a belt was run at such speed that it "whipped" itself to pieces, though it had never been satisfactorily decided that it was speed alone that caused the trouble, and it at once occurred to me that there might be some other reason than the first cost for not using larger pulleys, though I omitted to mention it to "E. B."

A visit was made to the belt makers—three different ones—and from them were obtained quite a number of new ideas regarding belting, the most important point for my contemplation at that time being that regarding the speed at which belts could be profitably used; that many improvements in the manufacture and better knowledge of the material had enabled them to materially increase the economical speed over what it had been a few years before, and without doubt it would be still more increased in the future, but it was not then considered advisable to run leather belting over 3,750 feet per minute for economy, though it could be used with safety, *if properly put on*, at 4,000 feet. (To-day many belts are being used that are far exceeding these speeds, though it is somewhat doubtful if it is economy to run them much over 4,500 feet per minute.) It was also said that to increase the width of a *fast*-running belt did not increase its power to do work in the same ratio that it did with the slower speeds, when used on rather small pulleys, such as were generally used on wood-working machines, for two reasons—one that the belt must naturally be a little stiffer, and so did not bend to fit the pulley snugly; and the other, that it was somewhat heavier and the centrifugal force carried it away from the face of the pulley to a greater extent, which, while but a very small per cent. in either case, prevented a proportional increase in the power transmitted, and that it would

be found much better to use two narrow belts than one of the width of the two combined if more power was required than could be obtained from one belt about five inches in width.

Returning to the drafting-room with a report of what had been learned, our "E. B." friend informed us that when he commenced building machinery it was difficult to get a belt that would stand to run over 2,500 to 3,000 feet, and it was therefore necessary to use very small pulleys on any arbor requiring high rotative speed, and that many wood-working machines—planers, for instance—had been built with pulleys on the cutter-head spindle but 3 inches in diameter, with a rotative speed of from 3,000 to 3,500 per minute; that they had found the two narrow belts better than one wide one, and therefore belted the heads at both ends, and that belts of those days over 4 inches wide did not give as good results as could be obtained with a width of about 3½ inches; that the better belts had enabled them to increase the sizes of pulleys and the speed of rotation, but that there was a limit yet, and the designers must be content to keep within the limits if they could find what they were.

Probably the average speed of cutter-heads on planers, molders and kindred wood-working machines is to-day not less than 4,000 revolutions per minute, and in many cases considerably faster than that. Calling it 4,000, we find the speeds of the belts to be practically—not exactly, however—as follows, in thousands of feet per minute: With 3-inch pulley, 3⅓ thousand; 4-inch pulley, 4⅓; 5-inch = 5⅓; 6-inch = 6⅓; 7-inch, = 7⅓ thousand feet; Harry Marquette, in "College Shop Experience," at page 422, describes the results of excessive belt speeds better than I could hope to do, as the particular style machine on which it is used "cuts little ice."

As a result, the sizes for the pulleys on this machine were revised, and while, if we were to redesign that same machine to-day, we could use some larger pulleys than were then adopted, there is a limit to the size that can be used advantageously, and I think that Brother Graves will find the wood-working machine manufacturers are always glad to increase the sizes of pulleys as fast as other influences will allow.

It might not be out of place for me to state that about five years ago I had occasion to interview sixty-two belt makers for a particular purpose, and in conversations with them the wood-working industry was spoken of, with the result that fifty-seven of the number said positively that they did not care to cater to the wood-working trade, and that while they would not turn down an order if it was sent to them, they would not go out after it, every one of them giving for the first reason the high speeds at which the belting was used, and then the dust with which it became coated in most cases.

DRAPHIST.

Lathe Design and Practice.

My analysis of some engine-lathe drives has resolved itself into an argument between Mr. Fish and myself, and if there were anything to be gained by continuing it I should be glad to do so; but I have no further proofs to offer than those already given, and if they are not sufficient I'll throw up my hands. If Mr. Fish still insists that the cone pinions are strong enough when they break, and that they are more easily replaced when broken than the quill pinion, why, I shall have to let it go at that. However, I would like to say something about Mr. Fish's article on Lathe Design and Practice.

Mr. Fish attributes chattering almost entirely to faulty headstock design. The reasons which he gives may cause chattering, but there are some other ones which he has entirely overlooked, viz.: the torsional stress on the spindle and the overhang of work which causes the spindle to vibrate, whether it is resting on the lower half of the box or on the upper half. Then there is the carriage, tool-rest, tool-post and, last but not least, the tool itself. Altering the shape of a tool will often stop or cause chattering. I believe it is pretty hard to tell just what causes a lathe to chatter, and I am reasonably sure it isn't always because there happens to be balanced or unbalanced forces between the weight of the spindle and work and the opposing force of the belt pull and the cut.

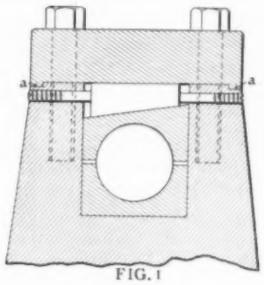


FIG. 1

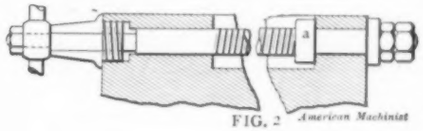


FIG. 2

LATHE DETAILS.

Many times I have started a cut which would run along for an inch or two and then begin to chatter, although the same condition, relative to forces, existed when the cut started as when the chattering began. How often, when turning on centers, have we put a small piece of waste or leather between the tail of the dog and the driving side of the face-plate slot? This forms a sort of cushion, and has stopped chattering many times for me. The action of the forces does not seem to hold good in this case, either. Someone else may be able to explain why this stops chatter, but I give it up.

The box which Mr. Fish shows in his Fig. 2, is faulty, I believe, for the reason that most of the wear is on the cap or top half of the front bearing, and to keep the spindle in alinement this wear should be followed up. If he is partial to the square box, why not use it, as shown in Fig. 1? In this way the top half of the bearing is always forced down, keeping the spindle fitted into the lower half, which was originally in line. Also, wouldn't it be better to have the strap span the headstock casting, as shown at *a a*? I believe a cylindrical box, fitted into a hole in the headstock, is just as good as one planed in square, and a great deal cheaper, although I never heard a lathe builder claim that such boxes could be duplicated and maintain the alinement. Most headstocks fitted in this way are bored, reamed and faced, and the boxes driven in tight. This driving would, of course, distort the box and make it necessary to scrape to a bearing again, no matter how accurately they were fitted before being driven in.

At page 528, Mr. Fish calls attention to the cross-feed screw, and I wish to add a suggestion. If it is better to have the screw under tensile stress, and I agree with him that it is, why not confine the screw at both ends, as shown in Fig. 2? Mr. Fish shows a collar at *a*, which is wrong, because the screw would be under compression when facing out or boring. Mounting the screw as in Fig. 2, but without the collar, the screw will always be in tension on account of being confined outside at both ends. Mr. Fish's cross-feed screw has right-hand threads, which is contrary to what we are used to in our part of the world.

ART. ISAN.

Proving Multiplication.

A reliable method of proving any example in multiplication is as follows:

12145	= 13	(1)	12145	= 13	(2)
542	= 11		542	= 11	
24290	13		23290	13	
48580	13		48580	13	
60725	143	= 8	60725	143	= 8
6582590	= 35	= 8	6581590	= 34	= 7

Add the figures in the multiplicand thus, $1 + 2 + 1 + 4 + 5 = 13$, and in the multiplier thus, $5 + 4 + 2 = 11$, and multiply the results thus, $11 \times 13 = 143$. Add the last figures thus, $1 + 4 + 3 = 8$, and we have one figure as a final sum of the multiplicand and the multiplier. Then add the figures in the product thus, $6 + 5 + 8 + 2 + 5 + 9 + 0 = 35$ and $3 + 5 = 8$, which equals the first final figure. Note the results in the second ex-

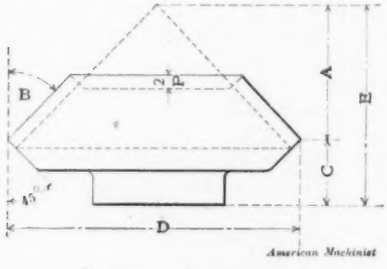
ample, an 8 and a 7, which show there is a mistake in the work. This method has never been known to fail, in showing a mistake where one has been made.

GEO. G. LITTLE.

Miter Gear Formulas—Reading the Advertisements.

Through the columns of the AMERICAN MACHINIST we have been treated, a good many times lately, to various bevel and miter gear formulas; some of which, for bevel gears, I have used with advantage.

I have, however, seen none for miter gears that are as simple and easily remembered as those given herewith. In my work we have simply had to machine the blanks, the cutting being done elsewhere, for which reason no cutting angles have been included, the gear-cutter operators taking care of those. It will be seen from the illustration that the face angle is given from a line parallel with the center line of the lathe in which the blanks are to be turned. If it is necessary to try the blank with a bevel, or protractor, it is only a matter of adding 90 degrees to the angle B or otherwise subtracting angle B from



MITER GEAR FORMULAS.

90 degrees, according to which side of the blank the angle is to be tested.

If D = outside diameter,
B = angle of face,
P = diametral pitch,
N = number of teeth,

$$\text{then } D = \frac{N + 1.414}{P}$$

$$A = \frac{N}{2P} - \frac{.707}{P}$$

$$C = E - A,$$

$$\tan. B = \frac{D}{2A}$$

The dimension E is the one generally given on a drawing, and of course represents the distance from the outside of the boss of gear under consideration to the center of the gear which meshes with it. Having calculated the dimension A, it is a simple matter to subtract it from E to get C; the distance from the point of the tooth to the outside of the boss.

A little practice with these formulas will enable anyone to commit them to memory.

There have been a lot of references lately in the AMERICAN MACHINIST to the advertisements contained therein and the relation and also proportion they bear to the text or reading matter.

In my opinion the reading matter represents the ideas of some workmen which they give to their fellow-workmen; and the advertisements show the ideas of firms who desire to convince other firms that those same ideas are the best in their particular line of manufacture.

If this latter be true, and I think it will not be denied, then it stands to reason that the advertiser will show his machine off to the very best advantage, every detail which adds to the efficiency of the machine being given full prominence. From this it would appear that the best way to study the developments of machine tools is to carefully read the advertising pages, which I consider is absolutely necessary to both employer and workman; to the former, because he learns what kind of tools are on the market which would, perhaps, prove very useful to him, and because he can also form some idea of what weapons the enemy (his competitors) are armed with and thus know where he will have to strengthen his own resources. To the workman, reading the advertisements is just as necessary as to the employer, because it is imperative that he should know what kind of tools his fellows in other shops are working with. He may want to move, and if he doesn't it will no doubt do him good to know how much behind the times he is.

Take the Cincinnati miller for an example; it is a liberal education to any milling-machine hand to read the advertised records of an up-to-date machine and also to see the jigs and fixings which are illustrated to hold the different pieces of work. The automatic screw machines, together with the examples which are generally shown, will help to show the average turner what a poor mortal he is compared with one of these machines.

Then there are cylindrical grinders. What wonderful records are given to us week by week in the advertisements relating to these machines.

Another class, which by no means exhausts the list, but which shows exceptionally well the strenuous competition between machine-tool builders, is found in the radial-drill advertisements. In the first place the Bickford company showed a gray-iron plate in which they had drilled 15 holes in about 26½ minutes. In a month or two the American Tool Works Company proclaimed a similar piece of work performed in 25 minutes, followed almost immediately by the Bridgeford company's announcement that they could do this work on their machine in 19 minutes. It is such advertisements as these which are of inestimable value to the workman, and which will prevent that complaint commonly called the "swelled head."

Clippings taken from the advertising pages of the AMERICAN MACHINIST will not only prove valuable references, but will also form an interesting history of the evolution of the numerous machine tools.

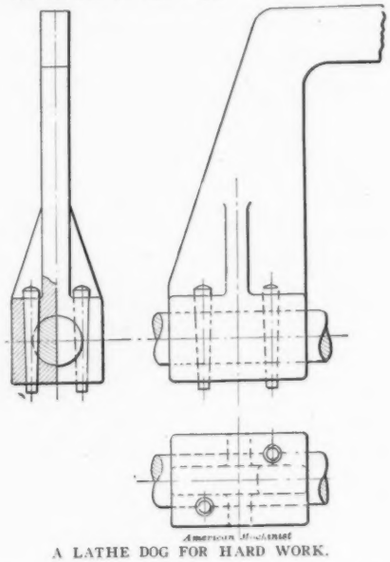
A feature of the twenty-fifth anniversary number was the article headed "Twenty-five Years' Progress in Machine Tools," but I venture to assert that there has been more change and progress since that article was written than there was between the tools contrasted there. I used to think there was "more poke (cloth) than pudding" in the AMERICAN MACHINIST when I started taking it, but I have veered around now till I think that the advertisements and the text are of equal value to the reader.

BEVEL.

Making Things Work.

The article at page 506 on, "A Device that was a Failure," seems to warrant the accompanying sketch, which illustrates a very probable means by which the fixture could have been made to work.

Inasmuch as the main trouble was the



A LATHE DOG FOR HARD WORK.

slipping of the lathe dog, it appears evident that it would have been cheaper to have made a special dog, than to have thrown the device away and continued turning the pistons in the old way. A dog similar to the one in the figure would undoubtedly have driven the mandrels without any trouble.

Mr. Menegus' attitude in the matter seems to have been prejudiced from the start. The fact that a man is "earning good money without working too hard" should not justify him in assuming an aggressive attitude toward any idea which might increase the output of his machine. On the contrary he should welcome any such change, as it is indirectly beneficial to him as well as to his employer. The difference between the device described on page 506 and the one on page 570 is plain to be seen. The one was not followed up and its failure taken for granted; while the other was pursued by its originator and made to work.

B. R. JUDD.

Indexing Arrangement For a Punch-Press.

The sketches show an indexing arrangement for notching, etc., as fitted to a Bliss power press, 2-inch stroke. It is shown as I first designed it, for perforating ventilator disks with perforations 45 degrees apart (rather an extreme movement for so short a stroke), which it did quite smoothly. It is obvious that with a fine-toothed ratchet instead of the one shown, various spacings could be obtained.

A is the platen of the press, *B* is a gray-iron casting, with the necessary boxes cast integral. The tool bolster proper fits on *B*, two studs fastened in the platen project through *B* and the tool bolster, securing them together when set. The elongated slots are for adjusting for various size blanks—from 12 inches down to about 6 inches. The bolster is of the bridge type, and with the tool stands the same height as the threaded collar *O*.

To fully understand the indexing part I think it will be best to refer to Fig. 2, which is a half section at *A' A'*. *B* is the base-plate, *I* the indexing plate with the ratchet wheel *X* keyed to it. *C* is the top cap with extension *D* for the stud in the lever *E* to work in. The spindle is a working fit in *B* just clear of the bottom. It is grooved and kept in position by the steel plug *Y*, a nice tension is obtained by means of the spring and screw, thus doing away with erratic spacing, or moving back when the cap *C* with its pawl is returning. The extension to the right of the base *B* ends at the boss for the pin and lever *E*. To the left the raised parts are for the sliding bar *J* and bolt *N*. The caps are screwed on as shown.

H is wrought iron fastened to the ram for carrying the cam-plate *G*. *M* is a bracket for the reciprocating lever *F*. *K*, on the other side, is for operating the slide bar *J*.

The front elevation at Fig. 1 shows how I arranged the stripper. The under side of the ram is drilled and tapped to take the two shoulder screws which are bored and counterbored for the cap-screws which hold the stripper plate; the usual rubber pads are behind the stripper. The disks I perforated were 11½ inches diameter—shown by dotted lines. The reading of the movement is as follows:

On the down stroke of the ram the cam-

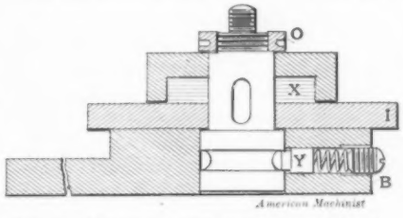


FIG. 1. DETAIL OF INDEXING MECHANISM.

plate *G* during the first inch of the 2-inch stroke, moves over the lever *F*, pulling the lever *E* which operates the cap *C* till the pawl drops behind the next tooth; the levers are then stationary during the rest of the stroke. On the other side, the finger *K* strikes *L*, causing the bar *J* and bolt *N* to move forward, the bolt *N* bringing the index-plate *I* into position and holding it there. This operation is done in ⅝ of the 1-inch stroke, allowing ⅜ complete dwell for blanking. On the return stroke, the ⅜-inch dwell allows the stripper to shed the blank. The next ⅝ inch the finger *K* leaves the bar *J*. The next 1 inch the levers return to their original position, cap *C* bringing the ratchet and plate *I* with it. The machine is kept going till the spacings are completed. The bar *J* is returned to its proper position by the spring and peg, as shown in section at *Q*. It is best when adjusting the plate *I* in relation to the bolt *N* to let the plate be thrown short so that the bolt *N* will draw the plate and ratchet away from the pawl, and not against it, which it would do if thrown past the center. By adjusting lever *F* along the pin in the cam-plate *G*, the index-plate *I* can be made to stop in any position.

There is nothing complicated about the arrangement; everything is kept as low as possible, the device should go under any press. The angles required to operate the lever *E* through the arc of movement, and *K* for the bar *J*, depend of course upon the stroke of the press.

England. W. REYNOLDS.

Water-Wagon Design.

F. R. Farnham, at page 649, gives as a reason for not locating the sprinkling apparatus on the front of a self-propelled water-wagon; that it would render its control difficult, owing to the lard-like surface produced on a macadam or asphalt roadway by sprinkling. If the surface of the roadway is examined immediately after sprinkling it will be found that a considerable interval of time elapses between the act of sprinkling and the de-

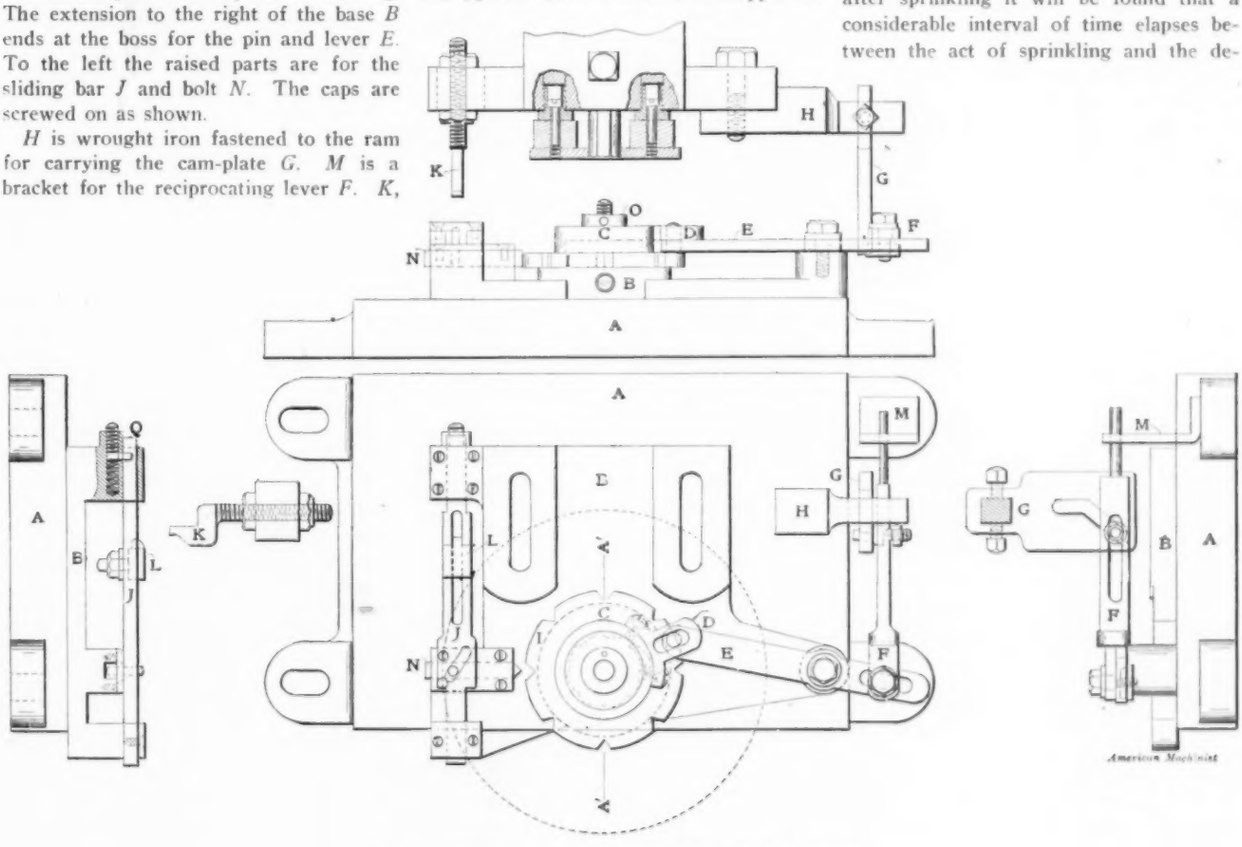


FIG. 2. INDEXING ARRANGEMENT FOR A PUNCH PRESS.

velopment of the slippery condition that Mr. Farnham mentions—if the roadway is dry at the time of sprinkling, which, of course, is the usual condition—and therefore no trouble should be experienced from slipping. Even if this were not the case, we know that comparatively high-speed trucks are manageable on sprinkled streets, and therefore a slow-moving water-wagon should be.

J. E. TERMAN.

Faulty Machine-Tool Design.

I found the recent articles on "Lathe Design and Practice" interesting and instructive, and while they probably said all their author desired, there is plenty more well worthy of attention by designers of machine tools, which, if attended to, would make their tools much handier to use, and at but small or no extra expense.

My attention has lately been called to some objectionable features in a small lathe which is widely used for tool-room purposes.

First—The tool block will not travel beyond the line of centers to permit holding small boring tools directly in the tool post by means of any of the holders so often described in your letters, which use V-block clamps and make a handy tool holder. This distance is short 9-64 inch. It is often convenient to get beyond the centers, and to my mind, at least, an inch is a great advantage.

Second—The stock in the tool-post is so short that it is impossible to use packing on top of the tool when doing delicate work with small tools made of wire or small straight bars, and without such packing the value of this style of tool is lost. The top of a ½x1-inch tool can be raised but 3-16 inch above the centers.

Third—The tool-post screw is so short that the wrench runs into the clamp handle of the tail spindle, and either the rest must be moved or the wrench taken off and the screw turned with the fingers when more than a bare loosening is required. The addition of three-fourths inch to the length would avoid this difficulty and also permit the wrench to swing clear over the small face plate.

Fourth.—The key in lead-screw for change gears is of the Woodruff style, and falls out every time a gear is taken off. Of course this gear does not require changing often; if it did this nuisance would be unbearable and call for a properly fitted and fastened key, but as it is the gear is changed so seldom that one forgets this key, and so it drops and must be hunted for nearly every time a gear is changed.

Fifth—The centers are of No. 2 Morse taper, but the holes are reamed just enough larger or deeper so that no tool of that taper as fitted to the regular Morse socket can be held without a sleeve of metal or paper. This may have its advantages in preventing the too common use of such tools in the center holes, but is sometimes a great aggravation in a tool-room lathe, where every convenience would be duly appreciated.

Sixth—The face-plate fit, so far as the screw thread is concerned, is all right, but the part chambered out next the shoulder is 1-16 inch larger than the top of thread, which makes it quite difficult to start the thread true when putting on plates or chuck, with the result that the thread often jams in starting, especially with a heavy chuck.

There is also a shaper of modern build and quite well known, in which an attempt has been made to put in some good points. The cross-beam is extended up behind the square lock of the knee-slide 2 inches in height, but the clamp-bolt for fastening the knee to column is 2½ inches down.

This shaper also has an outer support under the box-knee. The knee is 9 inches wide where it bears on this support, and the vise jaws are 9¾ inches long. When the vise is turned crosswise and one is planing the end of a piece outside the jaws, the knee is unsupported.

The travel of the knee on the cross-beam is 16 inches, and the result, when planing across a long piece, is that the planing is found to have a hump on the end, caused by running off the support. To avoid this, the support is let down and then the work is not square.

The vise is fitted with a spring locking pin seating in tapered holes for holding it either parallel with or at a right angle to the motion of the ram. This spring pin works through a block on the under side of the vise, but so far from the base ring that, except as a convenient approximation, it is not to be depended on.

Another case of misdirected energy in design I found in a gas engine. There was an adjustable box in the piston end of the connecting rod, adjusted with a screw in the end of the rod, but get-at-able only by taking the piston out of the cylinder, driving out the wrist-pin, adjusting the box to the pin while out and then driving it back again.

CHARLES S. BEACH.

Our Numerous Boiler Explosions.

At page 476 you comment on the great number of boiler explosions in the United States as compared with Great Britain.

On the extreme western edge of the continent, in a province that twenty years ago was scarcely known, we have a boiler-inspection act, which is strictly enforced by a staff of competent inspectors; and if our cousins across the line would pass similar legislation, I have no hesitation in saying that in a few years they would be able to report that the number of explosions had materially decreased.

If you will look over the accompanying report and note the defects discovered, you may be surprised; and in every case where these defects existed I have no doubt that the owners and operators considered their boilers perfectly safe.

Such stringent laws regarding the construction of boilers would be strongly opposed by *some* manufacturers I have no doubt, as was the case here; but that should not be allowed to have any influence on the question. You can build as good boilers in your country as in any part of the world, and there is no reason why you should not, and I hope ere long to hear that you have passed a boiler-inspection act to apply to the whole of your vast Republic.

T. M. G.

Vancouver, B. C.

Prony Brake Datum.

To-day I had occasion to refer to your recent article at page 127 by Mr. Halsey, entitled "Prony Brake Datum," and note that for this type of brake dynamometers he considers the horse-power capacity or rating to be approximately proportional to the product of the face and rim velocity and on this basis gets a constant (?) 23.37, which, when multiplied by the given horse-power, will presumably give the proportions of drum needed where the rotative speed is given.

According to this, if the dynamometer mentioned in the article had a drum diameter of, say, 15 inches, and ran at 500 revolutions per minute, it would have the same capacity as the 30-inch drum at 250 revolutions per minute. The total surface passing under the blocks is the same in each case. Note in Kent how the constant varies from 84.7 to 1,385.

I believe the capacity, for this type, is approximately proportional to the drum face multiplied by the circumference and is independent of the speed, except that it must not be too high nor to low or there will be mechanical troubles. This gives a constant of about 1 square foot per horse-power for the ordinary water-cooled type.

E. H. WARING.

[Kent's constant is figured on the same basis as mine except that the width of the drum enters his constant in inches, while it enters mine in feet, and his values should, therefore, be divided by 12 to make them comparable with mine. My value gave the point at which the brake broke down, whereas Kent's are, presumably, figured from the nominal capacity for which the brakes were designed, or at least from the capacity observed when they were at work and without breaking down. The capacity of a brake is, of course, limited by the capacity of the drum to carry away the heat, which depends on the dimensions of the drum only, and Mr. Waring's claim that the speed is not a factor appears to be well taken. It is, I must own, new to me and at first sight it certainly seems odd that the capacity of a brake is not increased by increasing its speed. Figured in this way the datum

from the Union Gas Engine Company gives .094 square foot per horse-power, which agrees nearly enough with Mr. Waring's figure.—F. A. H.]

Reducing the Diameter of Face Cams.

The accompanying illustrations, Figs. 1, 2 and 3, show how it is sometimes possible to keep down the size of a face cam. This is no new invention or discovery, but the papers on cams thus far published in the AMERICAN MACHINIST have, I believe, not shown that there is at times a choice in the laying out of the groove, and the location of the roller with a view to holding down the size of the disk.

When the motion of the roller consists of several steps, in one or more of which the acceleration is greater than in the rest, then these steps (which would appear in the cam chart with angles steeper than the others) should be located as near the outside of the disk as possible. The illustrations will make my meaning clear. Fig. 1 is the cam chart, which in this case is intended merely to show the positions of the roller which must be attained at definite points of the circumference. The constant for face cams given by Chas. F. Smith in the first paper of his series, namely 3.23 for an angle of 30 degrees at maximum velocity, will necessitate a circumferential travel of 3.23 inches, while the first step is accomplished in 30 degrees so that the necessary diameter is

$$\frac{360}{30} \times \frac{3.23}{3.14} = 12.3 \text{ inches.}$$

For the second step we shall again need a circumferential travel of 3.23 inches, but in this case the motion is accomplished in

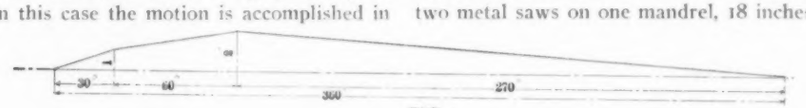


FIG. 1

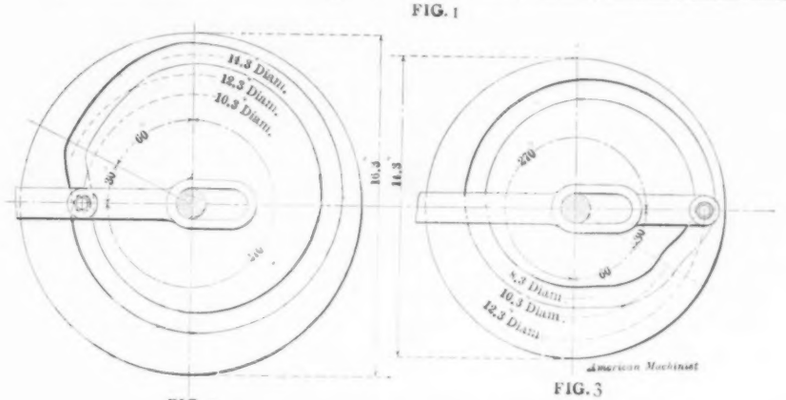


FIG. 2 FIG. 3

REDUCING THE DIAMETER OF FACE CAMS.

60 degrees, so that the necessary diameter for it alone is only 6.15 inches. It is therefore evident that the steps may be laid off from a diameter of 12.3 inches toward the center without approaching the limiting diameters.

Fig. 3 shows the groove laid off toward the center and Fig. 2 shows a groove to accomplish the same motion laid off away from the center. The arrangement of Fig. 3 requires the roller to be placed on the other side of the shaft center.

Of course this method is not applicable very often, as most cams have but a single step in the motion. L. E. W.

A Special Metal Saw.

On account of changes in character of the raw material used, a Western company, manufacturing fiber products, found it necessary to alter a large part of their machinery. The principal change was the removal of 18 inches in length from 75 machines which were all of the same type. Each machine consisted of two parts for performing successive operations, the fiber being worked at one end and finished at the other. The working parts were built in between two channel-section side frames of gray iron, in one casting about 10 feet long, 3 feet high and spaced 3 feet apart. The finishing end was taken up with rather complicated parts, while the other end from which the 18 inches was to be cut contained but a few simple pieces.

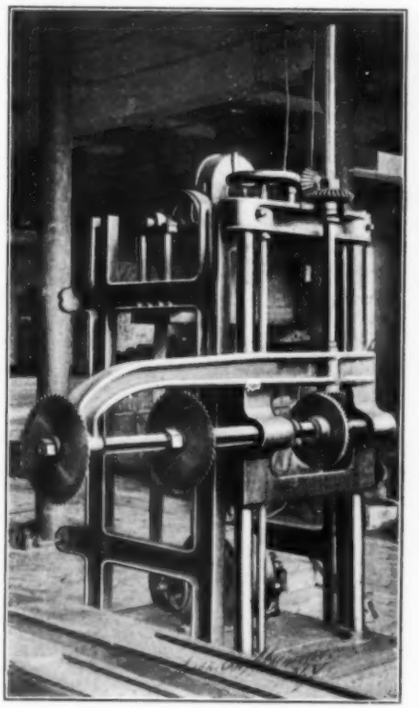
To the left of the saw is shown an end of a machine which has been cut and patched. The top cut was made 12 inches from the end, and the lower one close to the vertical piece. A long stretcher in the center was cut near one end.

The problem was to take the 18 inches out of the machines in the simplest way; *i. e.*, the frames were not to be taken apart, as few pieces as possible removed, and all work to be done on the mill floor.

The first and most important step toward the solution was the idea of using two metal saws on one mandrel, 18 inches apart, outside measurement. In this way it made no difference if the cuts in the sections were not started square with the frame, or the machine carefully set for the different cuts, as the ends of the sections from which the pieces were sawed would be parallel, and the pieces removed all the same length. When the frames were butted together again the end of the machine would still be square with the rest.

The saw, as shown in the half-tone, was built in the factory repair shop. While not a "thing of beauty," it is a good example of economy from the use of old material near at hand.

The motor for driving was an old 1½-kilowatt dynamo; it was belted to the first speed reduction, which had been a



A SPECIAL METAL SAW.

screw hoist. The side frames were from a discarded fiber machine, the screw and splined shaft from an old lathe, and the guides were pieces of shafting,

The saws (Brown & Sharpe) were 12 inches diameter, 5-16 inch face, ¾ inch pitch.

The method of operation was to set the machine to be cut underneath, and feed the saw down; also to set the saw and feed the machine against it by means of two jack-screws backed against a nearby wall. The jacks were connected by means of sprockets and chain, so as to feed simultaneously.

The frames were patched together with gray-iron plates, riveted on as shown in the photograph. Rivet holes made with an electric breast drill, rivets driven cold.

The saws were run at 40 feet per minute, but no record was kept of the cutting speed, as the iron in the castings was so variable. The average time for one man to set and cut a machine was about six hours. The saws were sharpened but four or five times and had no teeth broken, although in one instance they bit so hard that one bevel gear was stripped.

The work of the sawing machine was quite satisfactory, and the fiber machines are now all running in good order.

WILLIAM FINLAY MORGAN.

The Cutting Capacity of Power Presses.

At page 645 Paul Lange publishes some objections to the equations which I derived in an article on the above subject, published at page 496.

If Mr. Lange will express his p^m in parts of t as I have done it and which is entirely proper ($p^m = t\,p$), his formulas (4) and (5) will be identical with my (3) and (4).

Possibly Mr. Lange was mislead by taking my equation (1) as final, while it represents only the first step in the development of the equation (3). Unfortunately this equation is misprinted in my article, as it should read $l = \frac{A}{t^2 s p}$ Lange, is nothing but an application of this formula connected with the factor $p = 2/3$.

E. W. Zeh.

The Autarith.

Although our readers are continually dealing, directly or indirectly, with machinery in some form or other, we think that the greater number are not very familiar with the development which has been reached in the line of calculating machines, and we present herewith some pictures showing an exceedingly elaborate and highly refined mechanism of this class. This machine is of particular interest because of its "automatic" character, meaning thereby that it is only necessary to set the pointers to the given numbers, press a lever into the slot denoting the operation desired, and the electric motor which supplies the vital energy for this "mechanical brain" immediately starts and does not stop until the mathematical operation is completed and the result shown in figures through the openings in the face of the machine, no turning of a crank by hand being necessary.

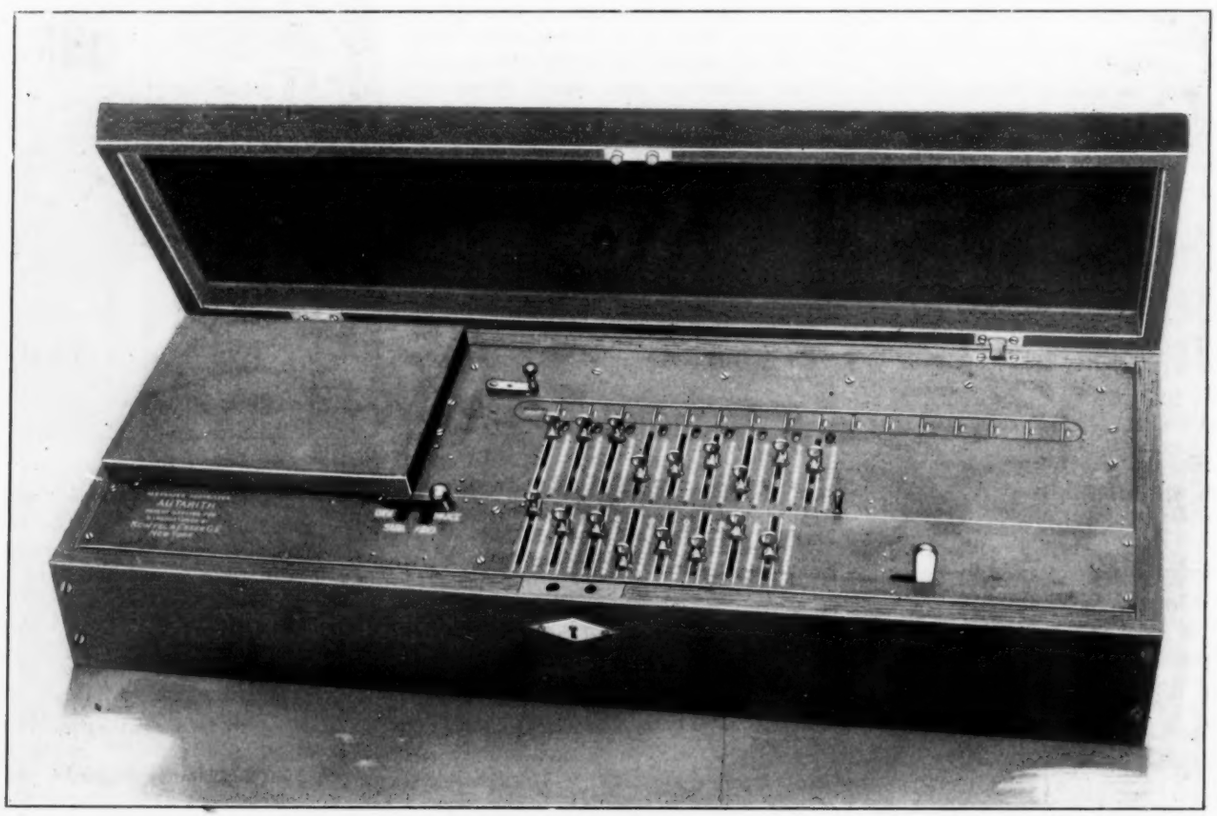


FIG. I. THE AUTARITH.

This typographical error is so easily detectable that I found it not necessary to call attention to it.

The diagram Mr. Lange shows is the very one I had in mind when I proposed a hydraulic bolster and indicator to actually find the factor p.

Mr. Lange's remarks regarding the formula $P = .5\ t^2$ cot. α are on the same level with his other objections.

Any method or formula to determine P, when inclined shear blades are used, has to be based upon the triangular cross-section underneath the upper knife. The value $.5\ t^2$ cot. α expresses this area.

The empirical method described by Mr. Jackson, which appeals so much to Mr.

Fig. 1 is an exterior view, the approximate dimensions of the case being 8½x 24x4½ inches high; the slots for the four operations—division, multiplication, addition and subtraction—with the controlling lever, can be seen near the left end of the machine. Through the row of sixteen openings in the background, which are formed in the cover of the sliding carriage, are indicated dividends or products; the nine pointers in front of them indicate quotients, or one factor in the case of multiplication; while the eight pointers in the foreground indicate divisors, or the other factor in the case of multiplication.

The small crank at the left of the first row of figures mentioned is for the purpose of setting that row back to zero before commencing any operation.

Fig. 2 is a view of the machine with the covers removed, and Fig. 3 a similar view looking down on it from above. The motor can be seen at the right-hand end of the illustration; it is about 1-16 horsepower. The sixteen wheels in the background bear numbers from zero to nine, the other sets of numbers being inscribed on the case and indicated by the position of the pointers in the slots. The pinions seen in the interior views, below the location of the slots in the cover, slide along the square shafts according to the position of these pointers; in the different positions they mesh with segmental gears beneath them, having varying numbers of teeth.

We will not attempt an exposition of the construction and workings of this complicated machine, as to make this plain would require a very extensive amount of space. It is sufficient to say here that the basic principle underlying the design is that of the famous Leibnitz

machine of the seventeenth century, which, of course, was manually operated throughout.

We called the machine a "mechanical brain," and in watching it perform the operation of division, a striking resemblance to the process of thinking becomes apparent. The machine performs this operation by successively subtracting the divisor from the dividend, each subtraction adding one to the quotient, all of which is done in plain sight. The machine will, however, always subtract the divisor once too often; whereupon an inscription at the left of the sliding carriage changes from "right" to "wrong" in red letters, the carriage moves up one decimal place, the machine adds the divisor to the dividend once, thus neutralizing the error, and starts on the process of subtraction again to obtain another figure of the quotient, this being analogous to the proceeding of a person bringing down another figure to the remainder in performing long division with pencil and paper. The process described is continued until either the exact quotient is found or until the machine has run out as many figures as possible, in which latter case the remainder is also indicated, and, if desired, the quotient can be set to zero and the division continued into this remainder, this being repeated indefinitely if necessary. It might be thought that the method of division by successive subtraction would be quite slow; however, the application of the motor drive causes the process to be gone through with much rapidity.

As has probably been inferred from the illustrations, the capacity of the machine is sixteen figures in the product.

This machine is the design of Alexander Rechnitzer, of Vienna, and it is made by the Keuffel & Esser Company, of New York. It has been named the Autarith.

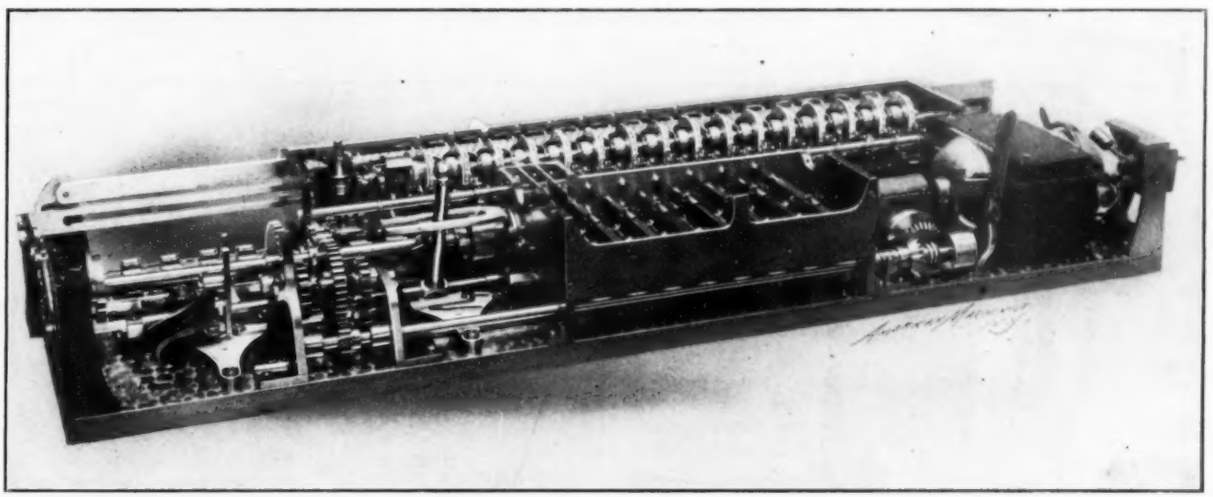


FIG. 2. MECHANISM OF THE AUTARITH.

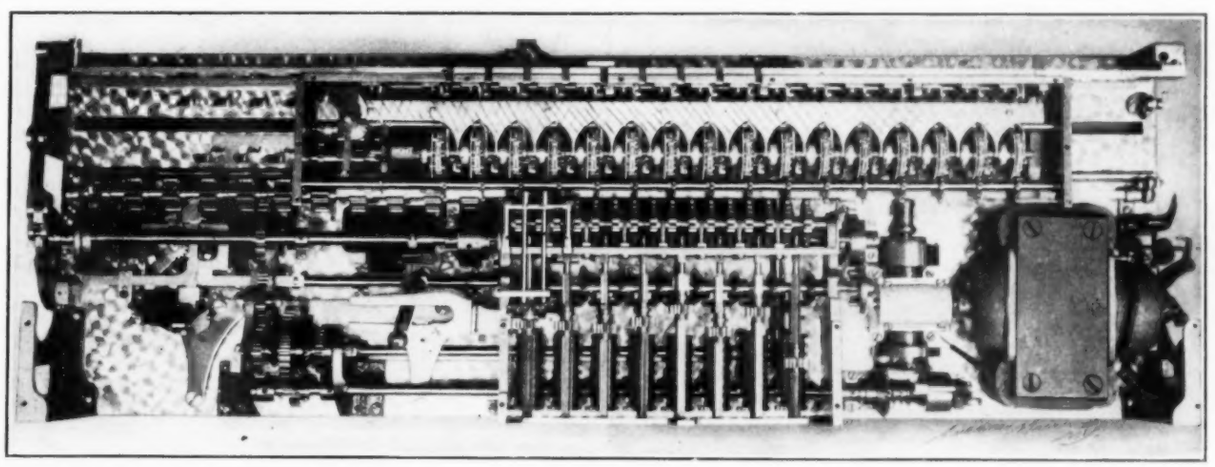


FIG. 3. LOOKING DOWN ON THE MECHANISM OF THE AUTARITH.

Business Conditions as Seen by Westinghouse Representatives.

The annual convention of the district managers of the Westinghouse Electric & Manufacturing Company was held at East Pittsburg, November 12-16. To the general public the chief interest in the convention centers in the general conviction of the participants that the immediate future contains the promise of great industrial activity.

The New England agent said that "the business outlook in New England was never brighter than at the present time." The New York agent considered the prospects for the extension of electric traction on steam railroads to be excellent. The Northwestern agent said: "Every indication in the Northwest leads me to believe that 1906 is going to be the greatest year in history." The Southern representative said that "the development of the South within the last five years has been truly phenomenal," and considered that this development was certain to continue. The Southwestern representative considered that his section was on the eve of "a greater development of the mining industry than has yet been dreamed of." The San Francisco representative said that "the people of the Pacific slope are looking forward to a period of uninterrupted prosperity." The Philadelphia district manager said: "If we have had successes and banner years in the past, I think the coming one will

make them look insignificant, as regards the amount of profitable business that is ahead of us." The manager of the export department considered that "the outlook for foreign trade has never been brighter in this country than at present." The second vice-president summed up the opinion of local representatives by saying: "We have every reason to believe that the industrial advancement throughout this country promises an unprecedented activity." It is to be hoped that all these hopes will be realized.

On October 12 a motor vehicle entirely protected by steel armor was demonstrated before the German Minister of War and a number of officers of the War Office at the military yards. The chassis was built by the Daimler Motor Company, and is fitted with a body comprising a seat for the driver, and back of the seat room for a number of machine guns, one of which was fitted to the car. The vehicle is protected with steel armor all around, and even the wheels, which, in order to allow of considerable speeds, are fitted with pneumatic tires, are covered with protecting housings extending almost to the ground. The demonstration was made by representatives of the manufacturers, and it is not by any means certain that such vehicles will be used in the German army.—*The Horseless Age.*

Automatic Wheel and Pinion Cutter.

The half-tones show a recently designed automatic wheel and pinion cutter possessing some novel features of construction.

This machine is of a size suitable for clock and instrument work up to 24 pitch in steel and from 3-16 to 5 inches in diameter, and is of the watch-tool type; the dividing head being fitted to take standard watch-tool wire chucks of regular sizes up to ½ inch for grasping arbor ends in cutting stacks of wheels, or holding the pivots or shafts of pinions, these chucks interchanging in the spindles of watch-tool lathes of the same maker, or the work may be held between centers. The platen is planed to the well-known section of the watch-tool lathe bed for the fit of the dividing head and tailstock, a method in keeping with the nicety of alinement necessary on this class of machine, where the pieces held between the centers are sometimes necessarily short. The spacing is by a system of notched index plates, locked by a spring-held swinging pawl, as shown in Figs. 1 and 2, the indexing movement being accomplished by a "single revolution" cam-shaft journaled in the side of the dividing headstock and independently belt driven from the countershaft, the "single revolution" cam-shaft being operated by a roller clutch which is tripped by a dog and the indexing accomplished during the quick return stroke of the platen. The cutter being lifted out of the work at the termination of each working stroke and held out during the return, permits the indexing motion to take place without loss of time, and also insures smooth work. The cam on the indexing shaft, lifting out the index pawl, will be noticed, in Fig. 2, at the rear of the headstock; also the connecting rod to the swinging pawl arm, which is journaled on a crank-pin adjustable in the hub of the cam to suit index ratchets of different numbers of teeth from 6 to 200.

Where gears and pinions are required having a high degree of accuracy and finish, the machine is arranged to carry a roughing or stocking cutter and a finishing cutter placed a short distance to one side on the same arbor, the roughing cutter first coming into action on all the teeth in the blank successively, then the cutter spindle slide being advanced automatically in line with the spindle to bring the finishing cutter to central position for the finishing cuts. This motion takes place without loss of time and during the return stroke of the machine, and the machine stops automatically at the completion of the finishing cuts.

The slotted link at the right-hand side of the machine forms the means whereby the travel of the table is adjusted from ⅝-inch stroke to 4½-inch, the full capacity of machine; also the oil pump and means

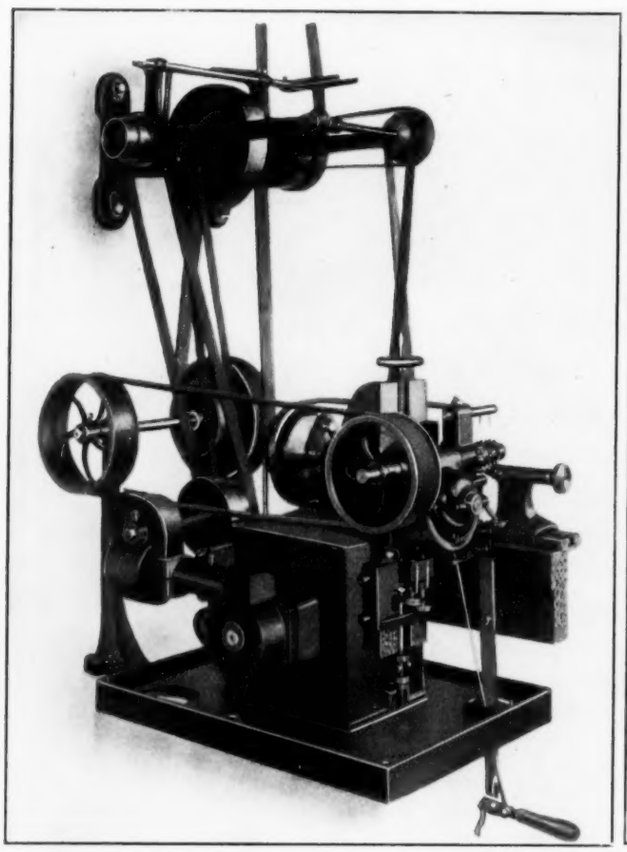


FIG. 1. AUTOMATIC WHEEL AND PINION CUTTER.

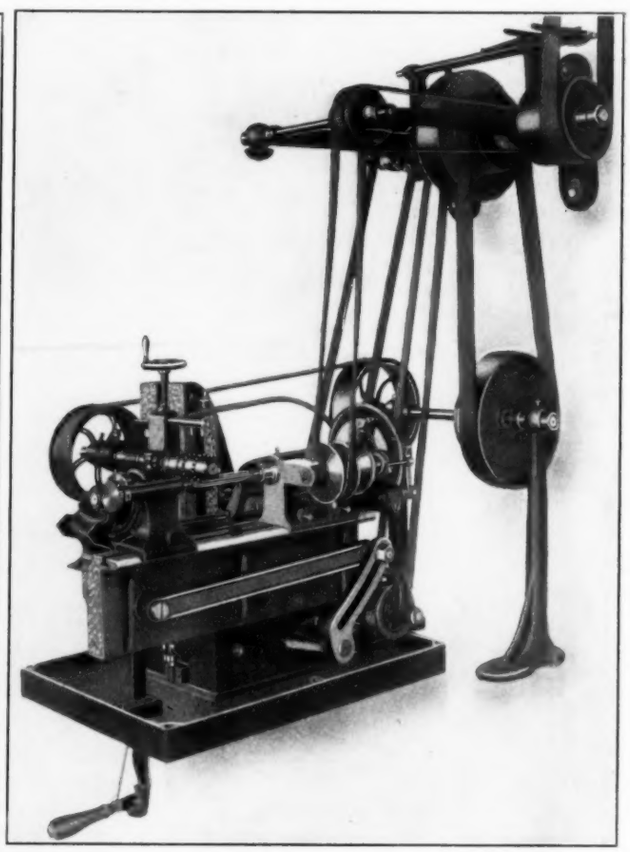


FIG. 2. AUTOMATIC WHEEL AND PINION CUTTER.

of piping oil to the cutters are shown at this point. The feed works are driven by a cone at the left of the upper counter belted down to a cone on the machine, the cone shaft driving through spiral and worm gears, the cam shaft inside the base; this arrangement gives 12 speeds to the table-operating cam, the number of

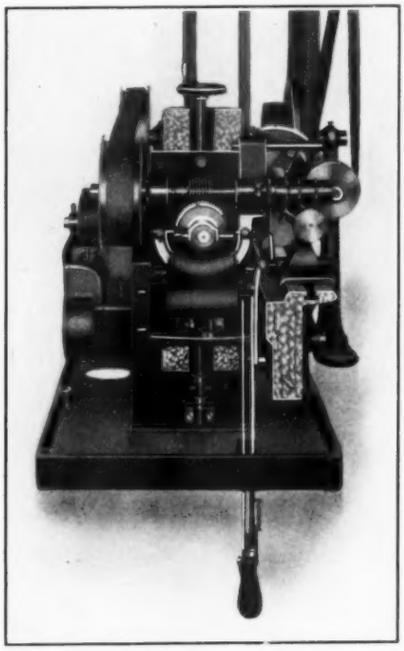


FIG. 3. FRONT VIEW OF WHEEL AND PINION CUTTER.

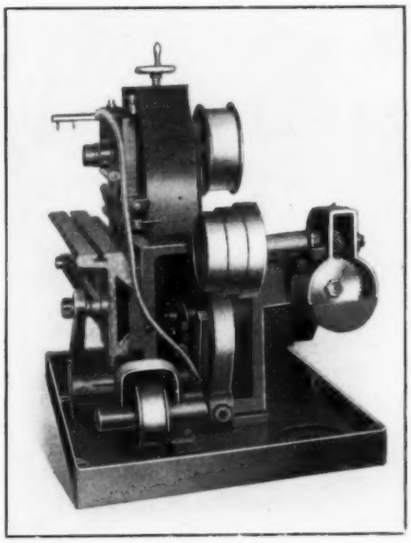


FIG. 4. REAR VIEW OF WHEEL AND PINION CUTTER.

strokes ranging from 1.8 to 30 per minute, giving feeds suitable for steel work up to 24 pitch, or for composition or brass gears of either fine or coarse pitch.

The cutter spindle is provided with 12 speeds from 75 to 1,600 revolutions per minute, a set of four pulleys, comprising one 3-, one 9- and a pair of 6-inch as shown on the machine, being furnished for this purpose; these pulleys interchange from cutter spindle to counter, and the bench counter having a two-step cone drive from the upper one in addition, thus doubles the speed range obtained by changing the pulleys above noted.

The front view in Fig. 3 shows clearly the "two cut" mechanism, with cover open, independent micrometer stops being provided to regulate the depth of each cutter. The machine can be furnished without this feature if desired. The rear view in Fig. 4 represents the machine, with the base door removed, showing the table-actuating cam mechanism and the cutter-lift cam; also the worm-gear feed box is shown to the right, with the cover removed.

The machine weighs 425 pounds without counters and is built by the American Watch Tool Company, Waltham, Mass.

The Action of the Disk Grinder.

BY F. N. GARDNER.

In a very unscientific way, I have attempted to analyze some of the phenomena observed in the process of disk grinding and the use of disk wheels. At the very start, and in fact all the way through, I find myself confronted with seeming contradictions and uncertainties. The conditions under which disk wheels are used are so infinitely varied that but few general rules can be given.

From my point of view, the abrasive grains on the surface of a disk wheel must be made to cut—actually cut—in the same way that a lathe, planer or milling tool cuts; otherwise they simply form the surface of a Reese disk and remove metal by melting it. If this principle is used, a soft steel surface is better than one covered with emery, as it will generate heat more readily and does not wear away so fast. The cutting action of a grain of emery on metal is, I believe, similar to that of the sharp corner of a broken file drawn across a metal surface with the intention of *scratching* it, more or less deeply as the occasion requires. If the corner of the broken file is sharp and is held in a position giving enough clearance and *rake*, it may scratch deeply with but little pressure; but if the point is blunt and the front or cutting edge is perhaps a very obtuse angle, it will require considerable pressure to make it take hold of the surface at all, particularly if the surface is hard. I have considered grains of emery as separate tools, each one independent of the other, and their cutting points to be of every conceivable shape, from what might be termed theoretically correct to the very worst imaginable, so far as free cutting is concerned.

If it were possible to place the grains of emery so that each would present its best cutting face to the work, we would undoubtedly be able to make ideal cutting wheels. But it seems safe to say that this is impracticable. A disk wheel faced with No. 24 emery will, when first set up, present from 100 to 150 cutting or scratching points to the work over every square inch of its surface. Ten to fifteen pounds pressure to the square inch on the surface being ground will remove soft steel effectively while the circle is new and sharp. But the high and sharp points wear off rapidly, bringing more and more points in contact with the work and requiring increased pressure to make them cut. After considerable use the points of emery become leveled down so that 400 to 500 per square inch may be in contact with the work, and many of them comparatively dull. It is evident in this case that the pressure must be increased to the endurance limit of the emery facing. If this limit is exceeded the emery will be stripped off the face of the wheel. But if the facing is what it should be, *i. e.*, of suitable temper and grain for the work in hand, an experienced operator will so regulate the pressure that the facing will not be stripped off, but will continue to cut effectively until fairly worn out. Roughly estimating, it may require 10 pounds pressure per square inch to make 100 points cut effectively, 50 pounds per square inch for 500 points. Five hundred cutting points probably considerably exceeds the number in No. 24 emery at any stage. As an average there will be, say, 300 points, which will require at least 30 pounds pressure per square inch. Increase the surface to 10 square inches, which is not unusual in disk grinder work, and the total pressure required would be 300 pounds. It is entirely practicable, by the use of a hand lever, to use this amount, or even twice this amount of pressure, to force the work against the wheel, but it certainly requires a powerfully belted and properly designed machine to stand up under such a load.

It is my intention to make a test in the near future with the object of ascertaining closely the power required to meet the above conditions. At present I can only estimate roughly that to grind a steel surface of one square inch at 30 pounds pressure per inch, will require about 1½ horse-power, and to grind a 10-square-inch area with same efficiency will require about 15 horse-power. Evidently the amount of power required will depend largely on the diameter of the wheels used. The larger the wheels the more power is required, but, on the other hand, the larger wheels will carry more emery and last proportionately longer.

It is my belief that there are still a great many things to be found out about disk grinding. The art, if I may call it such, is still in its infancy, being unheard of fifteen years ago. It would seem to merit some discussion from scientific and practical men, and I would be glad to start this ball a rolling.

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Contents.

	PAGE
The Water Hoist of the Lackawanna Company	723
Testing Powdered Coal for Locomotives	724
The New Works of the Ingersoll-Rand Drill Company at Phillipsburg, N. J.—V	725
Echoes from the Oil Country—A Foundry Mystery	729
54-Inch Rapid Production Boring and Turning Mill	732
Recent Improvements in the Newall Measuring Machine	734
Letters to the Editor	736-742
The Autarith	742
Business Conditions as Seen by Westinghouse Representatives	743
Automatic Wheel and Pinion Cutter	744
The Action of the Disk Grinder	745
The Demand for Engineers	746
Higher Costs and Lower Prices	746
A Question of Contracts	747
New Tools and Machine-Shop Appliances	748
Papers to be Presented at the A. S. M. E. Meeting	752
Meeting of National Machine Tool Builders' Association	752
Overcrowding in Technical Schools	753
Sanitary Condition of the New York Subway	754
Personal	754
Obituary	754

The Demand for Engineers.

We have on several occasions made contributions to the discussion, begun by *Engineering News* and continued at considerable length by *The Engineer*, of London, on the supposed superabundance of graduates in engineering and the consequent difficulty which such graduates are supposed to experience in obtaining employment.

The doleful stories which have been told do not seem to us to accord with the facts as they exist in this country, and we have given our reasons for our doubts. Feeling, however, that facts are easily accessible from those who are in immediate contact with the problem of placing engineering graduates in positions, we asked Professor Kimball, of Sibley College, Cornell University, to supply us with a statement of the experience of the employment bureau of that institution, and his reply appears in another column.

It appears that the experience of Cornell is not unusual. *Engineering News* for October 19 contains a letter from Professor Kent, of Syracuse University, saying that "in 1903 nearly every engineering college in the country had applications for about twice as many graduates as it could furnish," and that in that year and also in the present year the demand for engineers exceeded the supply.

Replying to this our contemporary asks: "Is it not a fact that a comparison between the number of current applications from employers to an engineering institution and the number of men in its graduating class is an unsound basis on which to found any broad generalizations? It is our impression that the employer who notifies Syracuse that he can give positions to, say, half a dozen young graduates, is likely to send the same notification to Cornell and Rensselaer, and perhaps other institutions in central New York; or, if geographical considerations are not important, he may send applications to a dozen or more schools."

On its face the objection is a good one. There certainly is no necessary connection between the number of applications and the number of vacancies, the only positive index of the situation being the actual finding of positions by graduates and, so far as the experience of Cornell graduates is concerned, this index is supplied by Professor Kimball, his most important statement being: "For a number of years there has been no trouble in finding employment for all graduates."

While not so directly applicable to the question in hand, there is a profound significance in the really imposing list of men who have visited the Cornell employment bureau on errands connected with the supply of men to fill their needs, this significance lying in the interest thus shown in technical education, which certainly shows a change from the time, within our own recollection, when technical graduates kept the fact of their being such in the background and in some instances took pains to conceal it altogether—feeling that a knowledge of it would be detrimental to their interests. Of course no one supposes that these men went to Cornell in search of leading men, or that they were prepared to hand out gilt-edged opportunities. As Professor Kimball puts it, "There is a demand, not for engineers, but for young men technically trained to learn."

The experience of the Cornell employment bureau certainly indicates that the condition of the American technical graduate is far from desperate.

In justice to *Engineering News*, however, it should be said that its position has been misunderstood. It has simply intended to point out that a large proportion of technical graduates do and must eventually find satisfactory work, not in the doing of engineering work, but in the conduct of business involving the doing of such work. In other words, that the business management of manufacturing and engineering enterprises is, other things equal, best placed in the hands of specially trained engineers, and that technical schools who wish their graduates to attain the pecuniary success now almost universally considered the only true hall-mark of genuine ability must give more attention to instruction which will fit graduates for managerial (commercial) positions.

Higher Costs and Lower Prices.

Our editorial at page 684 seems to have touched a responsive chord in the breasts of many machine-tool builders, and it is being realized that what is there set forth, specifically with regard to milling machines, is equally true of many other machine tools as well. A well-known builder of turning and boring mills, for instance, previous to the appearance of our article referred to above, had advanced the prices of his boring and turning mills, and also addressed a letter to other builders of such mills, in which letter he says: "With the rise in price of raw materials which has taken place recently, and the advance in the cost of labor, we cannot see how it is possible for the boring-mill people to go on selling their products at the old prices. There is probably no machine tool made that has been improved more in the last four or five years than have boring mills. All kinds of features have been added, which make them much more effective and increase their output at the factory. Weights have also been greatly increased. All these things have added much to the cost. Labor today costs at least 15 to 20 per cent. more than it did five years ago. In spite of all this, the prices of boring mills remain about the same. We are driving our factories to the limit, saving every dollar we can by the use of high-speed steel, improved labor-saving machinery, and modern shop methods, and we are giving

this all back to the customer, and getting little, if anything, from all of this effort ourselves."

The above-quoted paragraph from the letter referred to sets forth in plain language just about the position of the machine-tool industry in many lines, and we are convinced that, in justice, something ought to be done about it; our belief being also that something will be done about it, and that American builders will not be so foolish as to continue adding weight and expensive features, greatly increasing their cost, to the point of unsafe and unbusinesslike margins, without making some effort to better the condition of business in this respect.

A Question of Contracts.

In many industrial establishments it is not customary to make contracts with employees holding the various positions of responsibility, either in the mechanical or commercial departments; the view being taken that so long as the relations existing between the parties are mutually satisfactory, the engagement will be continued; whereas, when for any reason they become unsatisfactory, a contract will not make them satisfactory, nor effectually protect the interests of either party.

In other establishments contracts for various periods of time, running from one to five years, are the rule. Two establishments were recently consolidated, in one of which the first-named custom obtained, while in the other the last-named plan was followed. The result was that those employees who had been working for the first-named concern found themselves out of a situation, while those who had contracts were enabled to take positions with the amalgamation representing the two former companies, and the choice as to which men should be "let out" and those that should be retained did not much depend upon the efficiency of the men, or upon their ethical claims to their positions, but simply upon the contracts. Here were duplicate sets of men; one set had contracts, the other had none, and naturally those who had no contracts found themselves out of situations, and in most instances without much warning. Even the former director of the contractless company could do little or nothing for employees having no legal claims, much as he might have desired to do so. The moral would seem to be obvious.

Henry F. Shaw, of Boston, well known in railway circles for his devotion to the problem of balancing the reciprocating parts of locomotives, has presented to Purdue University a model locomotive embodying his latest design. The model is constructed on the scale of one inch to the foot, and is an excellent piece of work.

Every big fish began life on a small scale.

New Tools and Machine Shop Appliances.

SEMI-AUTOMATIC SPUR AND BEVEL GEAR CUTTER.

The illustrations show a new product of the Eberhardt Brothers Machine Company, of Newark, N. J., which is intended for use under circumstances which do not justify a series of full automatic machines. Only low-priced labor is required to operate it and, while the workmanship is of the best, the simplicity of the machine is of course reflected in its cost. The feed of the cutter and the trip at the end of the cut are automatic, but the return and the indexing are by hand. There is, however, no dial used in connection with the indexing. Change gears are provided for the different numbers of teeth, and the index crank is in all cases given an exact number of turns.

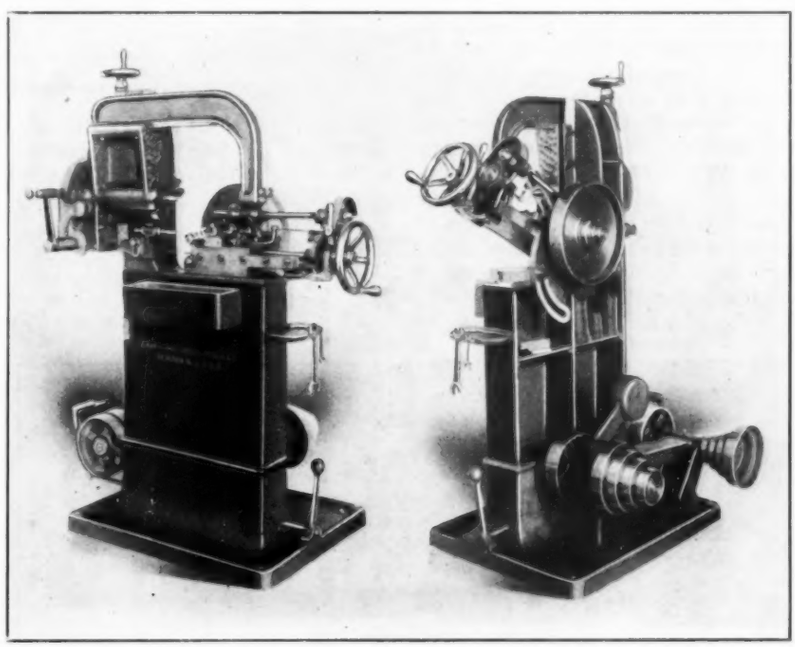


FIG. 1. GEAR CUTTER SET UP FOR CUTTING SPURS.

FIG. 2. GEAR CUTTER SET UP FOR CUTTING BEVELS.

The index wheel is made in sections and is re-hobbed in place after shifting the sections, thus making each one an original master wheel.

The work-spindle is provided with a No. 10 B. & S. taper hole, for receiving various work-arbors, which are drawn in and forced out by a draw-in bolt without hammering. A live center and dog-driver are provided for holding work between centers, in connection with the outside support. This permits of holding work on ordinary, or lathe mandrels, cutting solid pinions, fluting taps, reamers, and all similar work which must be done between centers.

The cutter-slide is adjustable to an angle of 90 degrees, by means of the graduated quadrant, for cutting miter and bevel gears, micrometer dials being provided to facilitate offsetting the cutter and rolling the blank. The cutter-spindle pulley runs upon its own bearing, and not upon the spindle, thus relieving the spindle of all strain of the belt. The cutter speeds are changed by means of the cone-pulley countershaft on the base of the machine. The loose pulley runs upon a stationary gray-iron bush, thereby avoiding any liability of the machine starting accidentally, as is the case when the pulley runs upon the shaft itself. The spindle belt is kept taut by a weight attached to the arm which carries the second cone pulley, and the center distance between the cones is adjustable for the same purpose, thus permitting the use of endless belts.

The machine will swing gears up to 20 inches diameter and 5 inches face, and will cut from the solid up to 8 pitch in steel and 6 in gray iron.

PORTABLE TOOL-POST.

At page 581 we published a description of the novel boring and turning mill of the Crocker-Wheeler Company, for which a portable tool-post has been made by the Espen-Lucas Machine Works, of Philadelphia. It will be remembered that the machine has no overhead works for carrying the tools, but that portable tools mounted in some cases on the table of the mill and in others on the surrounding floor plate are to be used.

The Espen-Lucas tool-post is intended to be used in either of these ways. A horizontal ram is carried by a heavy vertical post, and by star feeds at the bottom of the post may be fed in any direction.

In case the post is mounted on the table the stars are turned by a finger bolted to the surrounding plate, while, in case the post is bolted to the plate, the finger is attached to the table.

MULTIPLE-SPINDLE AUTOMATIC TURRET MACHINE.

The accompanying illustrations show an automatic machine designed for performing boring, turning, threading and other operations on castings, forgings and similar parts, also on pieces that have been finished on one end in a bar-stock machine. It is especially adapted to the handling of such parts as air-brake-valve bodies, couplings and nuts, globe valves, grease cups, compression hose and fuller bibbs, gage- and ball-cock bodies, valve stems, etc. Four sizes of the machine are regularly made and all but the smallest have four spindles each, these spindles being arranged in the manner indicated in Figs. 1 and 2. Each of the spindles carries a tool for a different operation, and the work is automatically indexed and fed up to the tools by a cam drum, which will be seen in Fig. 1, near the right-hand end of the machine. The work carrier, or turret, consists of a chuck provided with five distinct sections or sets of jaws, each pair of jaws except the upper one being in line with one of the spindles; the upper section forms the point at which the operator feeds the work to the chuck.

The drive for the four spindles and cam drum will be understood from the general views. The first spindle—the one in front—is geared, as shown, to a shaft driven independently from the counter, while the two lower spindles are geared together and driven by the large pulley at the end of the head. The threading spindle is provided with friction reversing pulleys and back-geared, the ratio in the case of the machine illustrated (which is known as the No. 23) being 4 to 1, while the lower spindles are geared from their driver in a 2.7 to 1 ratio, and the front spindle in a ratio of 2 to 1. The cam-shaft which feeds the work carrier up to the tools is driven from either the third or fourth spindle by change gearing extending to a shaft at the rear of the bed, this shaft being connected with the cam shaft—which extends the full length of the machine—by bevel and worm gearing. The feed drum is adapted to receive a cam strip fixed at the required angle, this being determined by the length of the longest cut required on the piece of work. An adjustable ring on the threaded end of the chuck shaft, or turret bar, forms a positive stop for each forward movement of the work to the tools. This stop collar will be noticed just to the rear of the indexing mechanism which brings the work into alinement with one spindle after another until completed. The feed clutch may be thrown out of gear and the feed instantly stopped by shifting the lever shown near the left-hand end of the machine. The chuck may be fed up by hand, when adjusting tools for new work, by turning to the left the worm shaft at the end of the bed.

The construction of the chuck is shown in Fig. 3. Each section forms a two-jaw chuck opened and closed by a right- and left-hand screw, and special false jaws are, of course, fitted to hold any shape of piece. As already stated, the work is placed in the uppermost section of the chuck and the first indexing movement then brings it into line with the tool in the first spindle, where the first operation is performed. In the meantime a second piece of work has been placed in the following section of the chuck, which is then in the upper position, and when the first piece is brought into line with the second tool, the first tool is operating on the second piece; thus each indexing movement presents each piece of work to a different tool and four operations may be carried on simultaneously; the operator simply takes out the finished parts and puts in the rough work without stopping the machine, and ordinarily can attend to two or more machines. While the tools are cutting the chuck is supported and relieved of strain by a bracket, which slides under the ledge of the chuck at the front of the machine. This bracket is visible in Fig. 1, and, as there shown, is attached to a lever which automatically draws it back out of the way of the chuck before the latter indexes, and then moves it to supporting position again before the tools start cutting. A taper bushing in the chuck body forms a means of compensating for wear

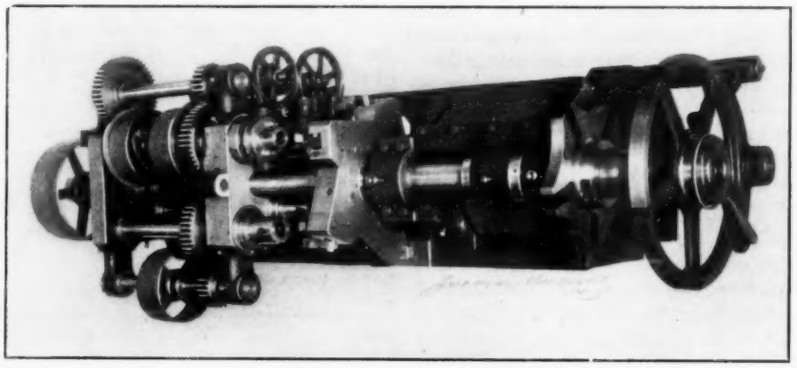


FIG. 2. MULTIPLE-SPINDLE AUTOMATIC TURRET MACHINE.

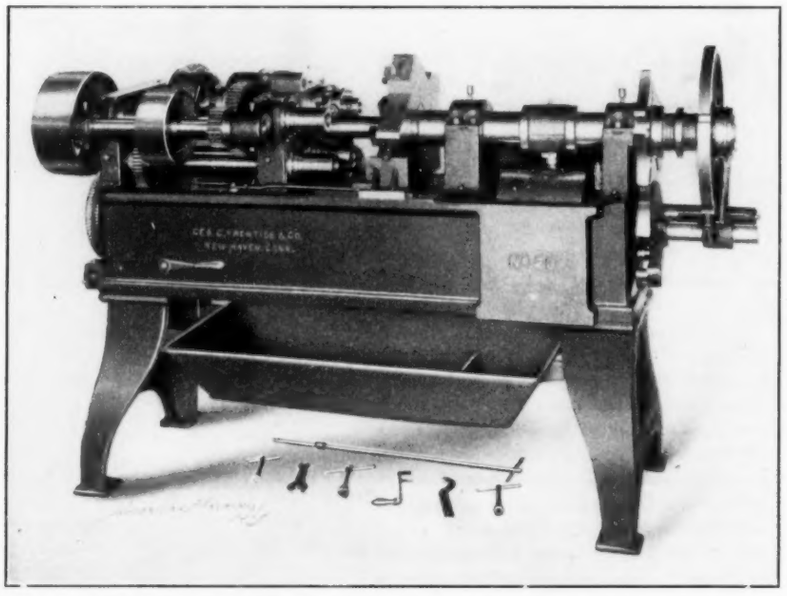


FIG. 1. MULTIPLE-SPINDLE AUTOMATIC TURRET MACHINE.

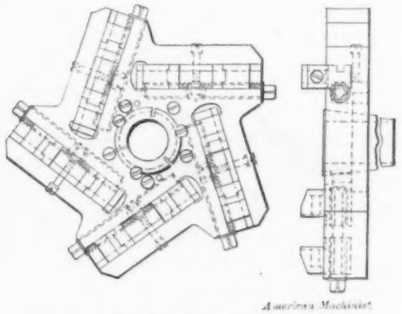


FIG. 3. CHUCK FOR TURRET MACHINE.

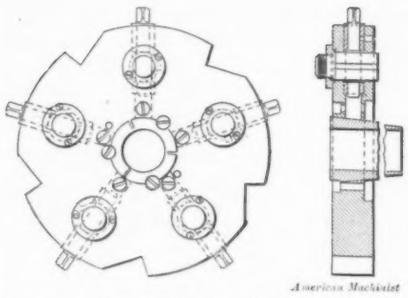


FIG. 4. FACE-PLATE FOR TURRET MACHINE.

between chuck and turret bar. For holding work that has been finished on one end and requires a second operation, an indexing face-plate is used in place of the chuck. This face-plate, as shown in Fig. 4, has five drawback studs or work arbors, which are threaded to receive work having internal threads, or provided with threaded collets for externally threaded work. After a piece of work has been screwed on a few turns by hand, a half turn of an eccentric stud draws it back tight against a hardened collar.

The spindles of this machine are ground and run in bronze bearings, the front bearings being taper, and all but the threading spindle have tool holders forged solid on the spindle. The frictions on the threading spindle are of an expanding ring type and controlled by a lever contacting with a tripping disk on the cam shaft. When an automatic opening die or collapsing tap is used, the threading mechanism is locked in the forward position, and the reversing belt removed.

Fig. 5 illustrates some of the tools adapted to this machine. The one in the upper right-hand corner is for cutting external and internal annular grooves, and consists of a shank and head with a cross slide and cutter moved at right angles by two wedges. For internal grooves the tool is carried at the center of the slide. A spring-actuated rod returns the slide as soon as the pressure on the work is

FIG. 5. TURRET-MACHINE TOOLS.

removed. The tool below is a hollow mill which automatically opens upon the completion of the cut. The three tools in the second row are tap and die holders, the middle one being a combination floating affair for cutting external and internal threads at the same time. The tap holder proper slides on two studs in the threading spindle, and the die holder on two studs in the tap holder, thus allowing a tap and die of different pitch to be used together. Both types of tap and die holders shown are arranged to be led on the work by feed mechanism. An automatic opening die is shown in the upper left-hand corner, and just below are a pair of adjustable roughing and finishing turning tools. Among other tools used are boring and turning tools, counterbores, etc., made of flat bar stock dressed on the grinder and inserted in holders.

The machine illustrated will turn a length of 5 inches and swing 5 inches outside of the chuck jaws. The false jaws open 3¼ inches. The threading spindle receives shanks 1 11-16 inches diameter by 4¼ inches long, and the other spindles have 1½x3-inch holes. The threading capacity is up to ¾-inch pipe or 1½ inches straight. The large driving pulley at the end of the head is 12 inches diameter by 5 inches face, and the pulley for the first spindle, 8x3 inches. The friction pulleys on the threading spindle are 8 inches diameter by 3½ inches face. The machine weighs 3,200 pounds and is built by Geo. G. Prentice & Co., New Haven, Conn.

MUD-RING DRILL.

A new multiple drill press, designed especially for mud-ring drilling, but well adapted to ordinary multiple-drill work, has the heads sliding directly on the main rail and arranged so that they may be spread to any desired center distance, each head being provided with independent adjustment. For such work as mud rings, where it is desirable that the heads should be adjusted collectively, they are clamped together by two quick-acting nuts which fix the center distance between spindles at 7½, 8, 8½, or 9 inches, as may be required. A dial on a worm-wheel on the right hand head shows the distance through which the heads are moving to the right and left.

The speed and feed changes are obtained by means of change gears, which are held in position by spring plungers, thus enabling the operator to change quickly from one speed or feed to another without lessening the available power of the machine. A dial on a large worm-wheel on the end of the machine shows where to set the dog to trip the feed at any desired depth.

The spindles are 1 13-16 inches in diameter, have a vertical movement of 12 inches, and work to a maximum center distance of 26¼ inches. The table has a transverse movement of 24 inches and receives between housings with a 12-foot rail, 10 feet 6 inches. Driven by a constant-speed pulley, the power is never less than that obtainable from a 5-inch double belt running at 1,696 feet per minute. The net weight of the machine is 17,500 pounds, and it is made by the Bickford Drill and Tool Company, of Cincinnati, Ohio.

THRUST-BEARING FOR VARIABLE-SPEED TRANSMISSION DRIVE.

At page 36 of the present half-volume we illustrated a thrust-bearing for the Reeves variable-speed transmission drive. The manufacturers of this device have

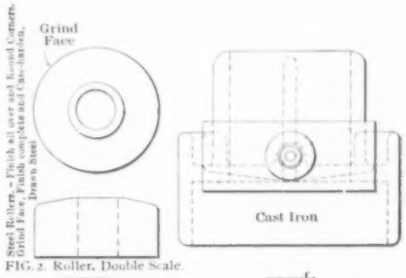


FIG. 2. Roller. Double Scale.

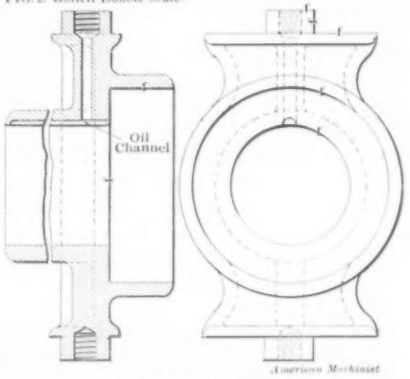


FIG. 1 Thrust Bearing Yoke

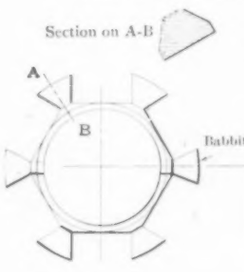


FIG. 3. Split Cage

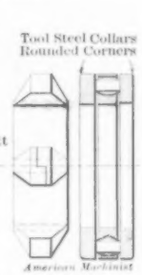


FIG. 4. Collars, Cage and Rollers Assembled

gotten up a thrust-bearing for the small sizes of the transmission which is somewhat different in detail from the one referred to, and we present herewith four figures showing these details.

As in the case of the larger size previously illustrated, one of these bearings is placed outside of each disk of the transmission. Fig. 1 is the "yoke" or shell of the bearing. In the large cylindrical opening on one side of this runs the split cage, Fig. 3, acting as a separator for the rollers, which it carries in its pockets, and one of which is shown in Fig. 2. The rollers roll betwen two tool-steel collars, as shown in Fig. 4. One of these collars,

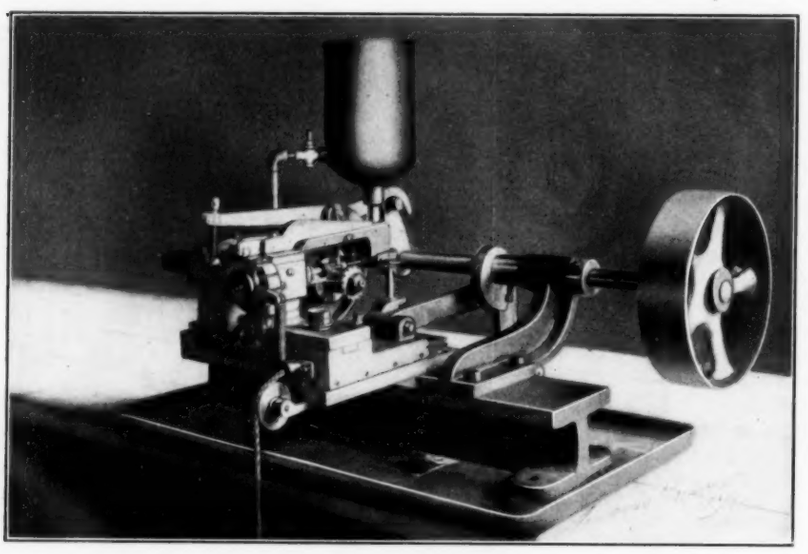
having a slightly larger bore than the other, is placed in the thrust-bearing yoke while the other one is placed on the shaft and bears against the disk hub, not shown in these drawings.

The outer ends of the steel rollers, as shown in Fig. 2, are made spherical so as to be accommodated to the curved interior wall of the thrust-bearing yoke and hold the rollers in perfect alinement, regardless of wear. The cage being split, it and the rollers may be removed from the shaft without disturbing the other parts.

These bearings are applicable to the Reeves transmissions, sizes 0 to 6 inclusive, and are made by the Reeves pulley Company, Columbus, Ind.

AUTOMATIC GEAR CUTTER.

This machine is designed for cutting gears of the finer pitches and up to 2½ or 3 inches diameter, though for special work the supporting arm for the work arbor may be arranged to admit larger diameters. The head carrying the work arbor passes the gear blank, or string of blanks, over the cutter, the working stroke of the cross-slide (about 4 inches) being derived from a cam on the driving shaft at the rear, while the return movement is by means of a weighted cord attached to the front of the slide. The indexing is accomplished automatically by a rock lever passing over the head and operated at the rear end by a crank on the driving shaft. This lever has, at the outer end, an adjusting screw, which contacts with the pawl carrier at the rear of the index plate; and the carrier, in its movement, first releases the plate and work spindle, and then indexes through the required number of notches, when the plate is again locked. The index dial may be readily changed and the movement of the pawl varied to suit the different number of teeth required to be cut. The slow speed necessary for the driving shaft, during the cutting stroke, is secured by means of a geared countershaft.

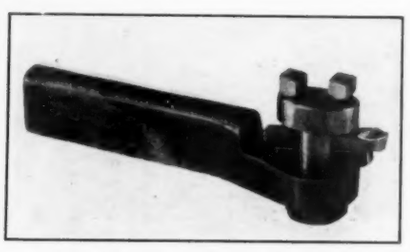


AUTOMATIC GEAR CUTTER.

The machine is built by the Matchless Cigar Lighter Manufacturing Company, 16 John street, New York city.

UNIVERSAL MILLING MACHINE.

The half-tone illustrates a universal milling machine having a positive geared feed drive and feed-change mechanism which provides for 20 changes of feed without stopping the machine. This mechanism is conveniently arranged at the back of the column and controlled by the levers shown mounted on the gear box. The spindle has a Brown & Sharpe No. 10 taper hole at the front end, a ¾-inch hole clear through, and runs in self-centering bronze boxes arranged to compensate for wear. It is back geared in 5 to 1 ratio, and three spur gears connect it with the feed mechanism. The drive is by a 2¼-inch belt on a 4-step cone having a maximum diameter of 10½ inches, and the 16 spindle speeds obtained in conjunction with a two-speed counter range from 15 to 335 turns per minute, the table feed per turn of spindle varying from .002 to .125 inch. The table, which has a working surface 37¼x7 inches, has 24 inches longitudinal and 8 inches cross feed by power in either direction, and the knee a vertical adjustment of 17 inches. The table is centrally fed and operates freely at any angle up to 45 degrees. The hand-wheels are provided with clutches—enclosed in the hubs—to operate the cross-feed and the knee movement. When either knee or saddle has been set to the position desired, the clutch may be disengaged instantly by pressing in the knob in the hand-wheel thus releasing the latter and preventing accidental movement of the table from the original setting. The adjustable dials indicating the various movements are graduated to read to thousandths of an inch. The dividing head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of the spindle is threaded the same as the machine spindle, and has a taper hole to correspond. The head is arranged for plain and differential indexing of all numbers to 360, and the ten change gears permit nearly any spiral from one turn in 1.25 inch to one turn in 68.57 inches to be cut. The index centers swing 10 inches and take in work 20 inches long. The T-slots for securing the head, etc., to the table are three in number and ⅝-inch in width. The distance from the face of the column to the braces is 16 inches, and to the arbor support bushing 11 inches when the braces are used. The steel overhanging arm is 3¾ inches diameter and the distance from the spindle center of the arm is 6 inches. The countershaft pulleys are 12 and 14 inches in diameter, and the speeds 125 and 150 turns per minute. The machine is known as the No. 1½, and weighs 2,500 pounds net. It is built by Becker-Brainard Milling Machine Company, Hyde Park, Mass.



A SWIVEL-HEAD TOOL-HOLDER.

A SWIVEL-HEAD TOOL-HOLDER.

The illustration shows a tool-holder—for use in lathe, planer, or shaper—having a swiveling head. It consists practically of a tool-post mounted on the end of the shank and having the usual shoe, so that

the rake of the tool may be altered. Owing to the fact that there are two binding screws on top of the tool, the shoe and the tool are less liable to rock under the pressure of the cut than when but one screw is used. As will be seen, the cutting

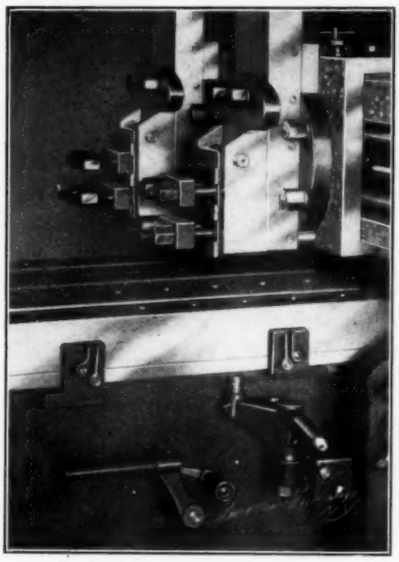


FIG. 1. A SHIPPING DOG FOR A PLANER.

tool is made of a small piece of bar stock of square section, of any grade of steel desired. This tool-holder is made by the Bown Machine Company, Ltd., of Battle Creek, Mich.

A SHIPPING DOG FOR A PLANER.

The illustrations show a shipping dog for a planer, which may be instantly moved and set while the planer is in motion, without the use of the wrenches or other tools.

Shipping dogs on planers ordinarily require frequent setting and sometimes quick adjustment. They cannot, therefore, be too readily movable. In high-speed planing the importance of being able

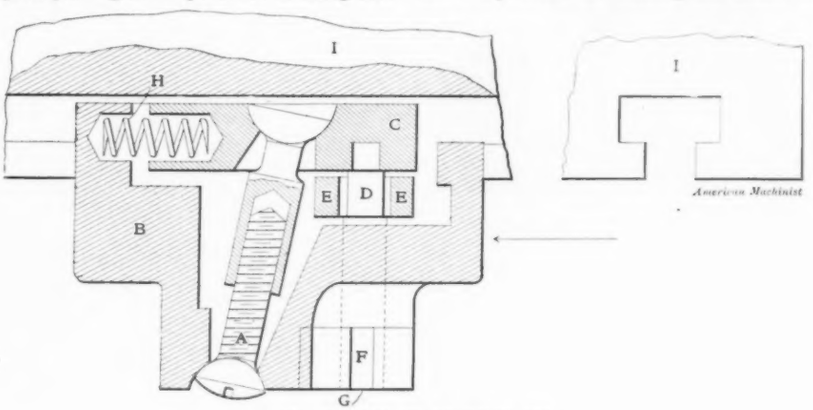


FIG. 2. SECTION OF SHIPPING DOG.

to release, move and set the shipping dogs very quickly is really great, and any difficulty in accomplishing these operations, even though apparently a slight one, such as that encountered when a wrench has to be used or when a tightened screw or nut has to be forcibly released and forcibly tightened again, acts to decrease the efficiency of the planer. Moreover, at high speeds there is considerable danger to the operator when he attempts to move and set the rear shipping dog while the planer is running, unless that dog can be moved and set with extreme ease.

Fig. 2, while not an accurate drawing, shows the way this dog works. *I* is a section of the planer table with the longitudinal *T*-slot for the dogs to slide in. *B* is the dog and *C* is a T-shaped nut sliding in the T-slot. *F* is the small lever which may be seen also in Fig. 1 alongside of the finger piece, which contains the screw head—in the shipping dog. *F* is secured to the spindle *G;* at the other end of *G* is the yoke *E* which straddles the pin *D* in the nut *C*. The bolt *A*—having spherical heads—connects the nut *C* with the dog *B*. The spring *H*—one end of which is seated in *B* and the other in *C*—forces *C* along the T-slot away from where the spring is seated in *B;* this force, in conjunction with the bolt *A*, tends to draw *C* against the inside of the T-slot, and *B* against the outside of the T-slot, and thus jams the shipping dog *B*. Any force—such as that of the reversing lever—acting in the direction of the arrow tends to tighten the dog *B*. When it is desired to shift the shipping dog, the lever *F* is moved toward *A*, throwing the yoke *E*, which moves the pin *D* and nut *C*—against the pressure of the spring—thus releasing the tension on the bolt *A*, the dog can be moved in either direction along the T-slot, which it grips firmly the instant the lever *F* is released. This device is supplied with the Whitcomb planers, built by the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass.

THE "CLIMAX" THREAD CUTTER.

This very simple tool consists of three parts—the chaser, the holder or shank, and a cap screw for holding the chaser in place. It can be used for either external or internal screw-cutting, the change requiring only that the chaser be removed and replaced at an angle of 90 degrees with its former position. This is clearly shown in the two illustrations, Fig. 1 showing the tool as ordinarily used for external threading, and Fig. 2 with the chaser arranged for internal threading. The advantages claimed for this tool over a single-point tool are more perfect work and greater rapidity of production. It is simple and strong and free from adjusting screws. The tool-holder is drop-forged and case-hardened, the chasers being made

FIG. 1. THE "CLIMAX" THREAD CUTTER.

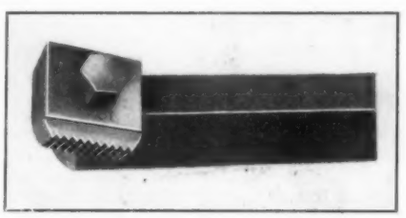


FIG. 2. THE "CLIMAX" THREAD CUTTER.

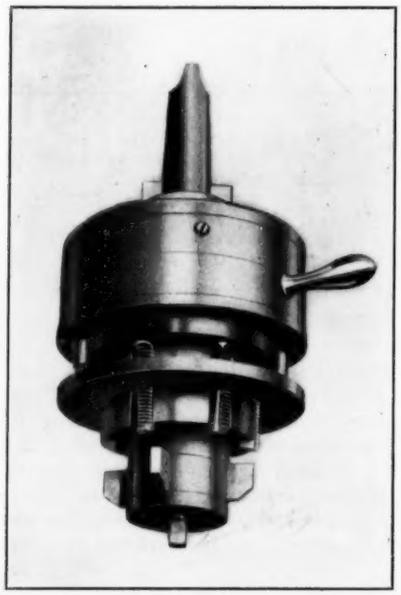
of tool steel or high-speed steel to meet requirements, either sharp "V," United States standard or Whitworth threads. These chasers are made by special apparatus designed for their rapid and accurate manufacture, which gives them the requisite clearance at the first operation, and the angle of the thread is maintained from top to bottom, so that repeated sharpening (which is done on the top side) does not alter it. The use of the center-gage is dispensed with in setting the tool to the work, and it is also unnecessary to use the thread-cutting gage attached to the cross-feed or to mark the screw and lathe carriage when applying the cut. The tool is set by placing it to line up with the work to be threaded. The single-pointed tool is usually set some distance to the right hand of the work; in setting the "Climax" tool, however, the work is covered a distance equal to the width of the cutter, and hence, if the chaser be 1 inch wide and the pitch be 10 to the inch, there would be ten revolutions gained with every cut taken, and from three to four cuts, it is stated, are sufficient to finish a screw of this pitch. Another advantage claimed is, where it is necessary to thread flanged and similar work on a lathe having no taper attachment, it is customary for the operator to set out the tool by guess as the lathe carriage travels, with the result that the work is often lacking in the perfection required for pressure parts; while with the "Climax" the tool is simply set to the proper taper and the work receives the same taper without any juggling of the cross-feed screw.

In cutting fine pitches with a single-

pointed tool, should the tool require sharpening before the job is finished, it is a difficult matter to return it to the same position, and more particularly so on a job of inside threading. With the tool illustrated, should it be necessary to grind it in the middle of the job, the tool-holder is not disturbed; it is necessary only to remove the cap-screw, take off the chaser, and, after regrinding, it necessarily goes back into the same position again. The maker of this thread cutter is P. J. Kelly, 514 Meadow street, Elizabeth, N. J.

AUTOMATIC COLLAPSIBLE TAP.

The tap shown herewith is provided with an automatic feature which causes



AUTOMATIC COLLAPSIBLE TAP.

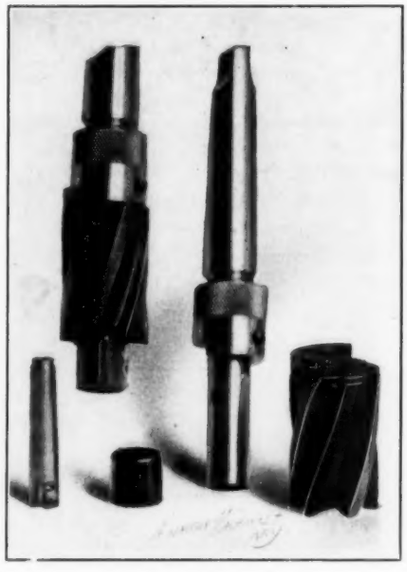
the teeth to be turned into the body of the tap when it has reached the desired depth, thus allowing it to be withdrawn from the hole without backing out. The particular tap illustrated is provided with an additional feature in the shape of a reamer, which reams the hole to the correct size to be followed by the tap.

The body of the tap is provided at its upper end with a shank, taper in the case of the one illustrated; the body has semi-circular grooves, parallel to the axis, formed in its lower portion, each of which contains a chasing cutter, itself semi-circular in section. The upper ends of the chasers project into the head of the tap, and are formed with two grooves in them, one above the other, and engaging with these grooves are two cam rings; the action of one being to rotate the chasers on their own axes, so that the teeth are forced out and held to their work, while the other cam ring tends to turn the chasers back into their recesses. Both cam rings are actuated by the handle seen projecting out horizontally in the picture. In practice the handle is used to set the chasers in position to cut, whereupon two spring-actuated locks at diametrically opposite sides drop into place and hold the cam rings and therefore the chasers in the cutting position until the tap is collapsed. This is accomplished by the ring which surrounds the body of the tap striking the work, and by means of its supporting rods the locks are released, allowing another spring contained in the head to pull the cam rings around and turn the chasers into the grooves. The tap can then be drawn out of the hole.

The body of the tap is bored and threaded to receive the reamer. The seats for the reamer cutters in the reamer body are machined, and the cutters, made from high-speed steel, are inserted without machining, being simply sawed off from commercial stock. Their inner ends bear against a taper screw, the square head of which shows in the picture at the bottom of the tool; by means of this screw the cutters can be adjusted for wear so as to maintain the proper diameter of holes. After adjusting, the cutters are clamped by the screws in the circular bottom plate, this plate bearing on the lower edges of the cutter bars. This tap is made by P. J. Kelly, Elizabeth, N. J.

A NEW SHELL REAMER.

The accompanying half-tone shows a tool for the purpose of counterboring, facing and reaming with or without guide. The advantage of this tool over the old



A NEW SHELL REAMER.

style counterboring tool is the quickly removable guide and cutter, enabling it to be readily ground on its cutting edges, perfectly true to insure a straight surface on the work. On the old style this is a rather hard task to perform without injuring the guide, and besides the backing of the cutting edges has to be done by hand in most cases. The shank is turned to fit the shell cutters and the driving locking collar, the collar being a sliding fit, driven by the shank through a key. The headless screw, as seen in the cut, is used for location of the key in the collar and to create a certain amount of pressure on the shank. The length of the keyway in the shank is dependent on the vertical adjustment by the nurled nut.

The end is bored and reamed to Brown & Sharpe taper, the size depending on the size of the shank. The master pilot is then inserted and fitted so it is removable by means of the knock-out hole in the shank. The shell lock is constructed in such manner that by slipping the shell up to lock and turning to right, the tool is ready for operation, there being no screw or key to fasten. The shell guide, which fits on the master guide, is locked in a similar way, as the illustration will readily explain. The attaching and removing of the shell cutters and shell guide is but a moment's work, and the time changing for different sizes is cut to a minimum. The tool in the cut is made to hold cutters from 1¼ to 2¼ inches, inclusive. This tool is made by G. Burki, 415 Logan avenue, Milwaukee, Wis.

Papers to be Presented at the A. S. M. E. Meeting.

As will have been gatnered from our previous announcements, the coming A. S. M. E. meeting will be different from its predecessors, and the recently issued program in full shows that this will be so in no way more than in the arrangments for the presentation and discussion of professional papers. These will be much fewer in number than usual. The first will be presented Wednesday morning, and will be entitled, "Use of Natural Gas Under Boilers," by Jay M. Whitman.

The next will be presented Thursday morning, and will be entitled, "Reinforced Concrete Applied to Modern Shop Construction," by E. N. Hunting. This, however, will be preceded at that session by papers not yet announced specifically, on "Bearings," and this subject will be discussed, as well as other subjects coming under the head of "Topical Discussions."

Friday morning, the following papers will be presented and discussed: "Measurement of Air Flowing through Circular Orifices in Thin Plates," by R. J. Dudley; "Results of Preliminary Producer Gas Tests, United States Geological Survey Testing Plant, St. Louis, Mo.," by R. H. Fernald; "Pressure Drop through Poppet Valves," by Charles E. Lucke; "Test of Elevator Plant, Trinity Building, New York," by A. J. Herschmann; "The Realization of Ideals in Industrial Engineering," by H. F. J. Porter.

Meeting of National Machine Tool Builders' Association.

The National Machine Tool Builders' Association will have a special meeting Monday, December 4, at the Hoffman House, New York, at 10 A. M.

Overcrowding in Technical Schools.

BY DEXTER S. KIMBALL.

With reference to the matter of overcrowding in the engineering profession in America, regarding which considerable discussion has been printed of late, is it not true that the same condition exists in about all walks of life? We have too many doctors, lawyers, preachers, teachers, clerks and, except in extremely good times, too many mechanics of all kinds.

Neither is there anything startling in the statement that many of the technical graduates are not what they ought to be. Not all or even a fair majority of the men found in the other above-mentioned callings are what might be called first-class at their professions or trades. It would be manifestly as absurd to expect every boy who enters a technical school to become a good engineer as it is to expect every boy who enters the machine shop as an apprentice to become a skilled mechanic of the highest order. There does not seem, however, to be any overcrowding at the top of any profession or trade, including that of engineering, and a careful examination will show that the engineer of inferior ability or training stands a better chance of finding something to do than men of some of the other callings.

A few years ago it was the custom of all practical men to look with more or less contempt on the college-bred man. This was to a great extent the fault of the schools themselves, as no doubt the instruction had a tendency to make the graduates hold too high an opinion of their abilities. This state of affairs, however, has happily about disappeared, and now our first-class technical schools even do not pretend to turn out engineers in the generally accepted meaning of the term, but simply men well grounded in the fundamental principles that underlie engineering, with whatever knowledge of the practical application of these principles as can be well given in a technical school. On this footing the employer has found that he can use the graduate, and the young man himself finds he can get a start.

Now, as has been pointed out, it would be a remarkable thing indeed if all these young men were capable of becoming first-class engineers, even if they had got all there was to be had from their college course. But, nevertheless, they all do find employment in this country, at least, and at the best of our technical schools in even fairly good times there is an actual demand for these men.

As evidence that this is so, note the conditions at Cornell, which may be taken as representative of the best of the technical schools. In a paper presented before the American Society of Mechanical Engineers in 1899, the following statement occurs:

"The very surprising fact that the total number of students in technical colleges in this country is at present on the decrease may suggest that some changes in the engineering courses would better meet the needs of a larger class.

"This unexpected falling off in the number of engineering students is greater than can be accounted for in these prosperous times, amounting to 15 per cent. from 1894 to 1897. These facts were first shown by Dr. Wardsworth, president of the Michigan College of Mines, and since verified by Mr. Wiliam Barclay Parsons, trustee of Columbia University."

It will be seen then that this is not a new issue and at the time of the presentation of the paper it was pointed out in the discussion that these statements did not seem to apply to our best schools, at least not to Cornell. At present, ten years after the period spoken of (1894-1897) we find the attendance at Cornell, in spite of increased tuition and higher entrance examinations, to have steadily risen from 510 in 1895 to 1,080 during the present year. Manifestly, if there was any great difficulty in finding employment for these young men, this steady increase would not continue.

The work of caring for the correspondence with manufacturing companies on this subject is considered so important at Cornell, and has become so large that a special committee has charge of the work. The following is taken from a report of the chairman, Prof. H. H. Norris.

"As you are aware, the Employment Bureau has received many more applications for men than could possibly be filled, and they have been greatly encouraged by the attention which has been given this matter by the large as well as the small operating and manufacturing companies.

"We have recently been visited by the chief engineer of one of the largest locomotive works in the country; by the sales manager of the largest manufacturers of wind-mills, gas engines and scales in the world; by the chief engineer of one of the finest engineering firms; by the electrical superintendent and the engineer in charge of the drafting department of the largest electrical manufacturing company; by the vice-president of a combination of companies making machine tools; by the treasurer of a very large agricultural implement firm; by the chief engineer of one of the largest telephone operating companies in the world; by the president of a most important firm manufacturing small tools; by the manager of the Atlantic district of one of the largest blower companies; by a prominent sales engineer of the largest manufacturer of brakes for all kinds of cars; by the sales engineer of the largest telephone manufacturing company in the world; by prominent engineers from three of the largest generator and motor manufacturing companies, etc.

"This list serves to show the character of the people who come here for the purpose of interviewing our students.

"You will understand that the demand for men is not that they may be placed at once in responsible positions, but that they may be given an opportunity to learn the various lines of business and to fit themselves for positions of responsibility. The Employment Committee has every reason to be encouraged and *the demand for technically trained men appears to be on the increase.*"

Again quoting from an address of the late Dr. Thurston (Science, Vol. XVII, 1903).

"A list of one thousand [graduates] has been prepared for me, tabulated. The average period since 'graduation' is about seven years. Of these, so far as reported, one-third are holding positions of independent responsibility; one-eighth are managers and superintendents of works; 10 per cent. are teaching in the professional schools, and twice or thrice as many are wanted.

"Ten per cent. are designing engineers, planning the machinery of work-shops, the manufacturing establishments, the railroads, and the fleets of the country. Several are editors; one-fourth are manufacturers; many are presidents and vice-presidents of corporations; others are treasurers, and the balance are distributed throughout the whole system of industries in the country. One-half of these men are not above an average of twenty-five or twenty-eight years of age, and 95 per cent. are not above thirty-five or thirty-seven. Practically all retain their connection with their profession. They commonly realize and fully appreciate their advantages, educationally."

An examination of the Alumni Register of Lehigh University, just received, shows a close corroboration of Dr. Thurston's statement, the list of industries into which the graduates enter covering the whole industrial field, the percentages for the callings as given in Dr. Thurston's report checking closer than would be expected.

It is to be noted especially that the greatest percentage of graduates do not go into engineering as strictly understood, but into many of the allied callings or industries. And it may be here noted that the technically trained student enjoys a privilege not common to all professionally trained men. The training of a doctor, dentist or a lawyer, for instance, fits him for only one thing, and he finds it difficult to find employment in other callings if his own specialty is overcrowded. But engineering in a broad sense is an unlimited field. This has been well pointed out in an able editorial in the Engineering News of October 19. In that same issue the following advertisement appears:

"Wanted—Young man to learn the contracting business; Technical graduate preferred; low salary to start; good opportunity for advancement."

Ten years ago a man who would insert such an advertisement would have been considered mildly insane to say the least. Yet this advertisement states the situation exactly. There is a demand, not for *engineers,* but for young men technically trained to *learn* an almost unlimited line of pursuits all more or less intimately connected with engineering, and such will continue to be the case as long as this country continues to grow and develop. The engineering field in a narrow sense will always be one of competition, as will any other field where the prizes are large, and no young man, generally speaking, must expect to obtain a prize in any field except through competition and a long experience, starting at the bottom. This is a statement of conditions as they exist at Cornell and presumably at any other institution of like standing. For a number of years there has been no trouble in finding employment for all graduates, last year in particular the call for these young men being actually a demand. Any conclusions reached on the basis of a number of actual practicing engineers as compared to the number of men in the technical schools are therefore misleading.

As to whether our schools are giving the best preparation for the field open to its graduates is another question. As far as preparation for engineering in a strict sense is concerned, it would seem from the number of successful ones as if it were fairly adequate. And at present it is the nearest approach to suitable preparation for engineering in a broader sense, or industrial life, as it may be called. There is no question, however, that this broader aspect of engineering or industrial life is calling for some modification of the strictly scientific training of the technical school, and at Cornell an effort is being made to meet these new conditions. (See *Sibley Journal,* June, 1905.) But part of the real trouble lies farther back and must be looked for in our secondary schools. Not all the students entering a professional school are by any means fitted naturally to become specialists, and anyone familiar with conditions as they exist knows the vague state of mind with which many freshmen begin their college career. In many cases it is an experiment either on their part or the part of parents or guardians. Naturally under such circumstances, even with a vast field open, there is waste material among the graduates even though they have completed the course of study. No doubt many students enter our higher technical schools yearly who should have been diverted into other walks of life or to trade schools, and no doubt also many students never get through the high schools, even, who would make good engineers.

Such a system is necessarily wasteful, and the universities will continue to send out from all courses many men who are either misfits or who are poorly prepared as long as it is continued. And only when our secondary school system gives the boy not only a liberal training as a foundation, but trains him for the possibilities that may lie in him rather than for the possibilities which some technical school may open to him, will the boy come to the university with a clear idea of where he is going. And only, in addition, when our universities can offer other forms of higher education between the strictly professional at one extreme and the strictly indefinite at the other, will the turning out of misfits cease. Many of those who do enter the technical courses are compelled, through lack of ability in the particular line chosen, to drop out in the first or second or even third year. These men often go into other professional schools and do well. The great growth of technical schools is simply the outcome of the need of a kind of higher education for the broad field of industrial life which the classical curriculum does not meet, but which the technical school meets approximately. Modern industrial life is very complex, even every small branch is a specialty in itself, and while every man should have as broad and liberal foundation as possible, he should also be started along the right road to the specialty for which he is best fitted, for he has no time to spare.

Sanitary Condition of the New York Subway.

The report of Geo. A. Soper, consulting sanitary engineer, appointed some time ago to investigate the sanitary condition of the New York subway, has been made to the Rapid Transit Board. It reads in part as follows: "Regarded as a whole, the results so far obtained give little cause for alarm concerning the sanitary condition of the air of the subway. The principal objection is its high temperature. The sanitary significance of the presence of black dust and of bacteria which are contained in the subway air still remain to be settled." As to the ventilation, the report states that there is more fresh air in the subway than is necessary to satisfy the demands and standards of the sanitary authorities. In the cars the conditions are less satisfactory, due to the crowding in the rush hours. He admits that there is an odor at all times in the subway. This is due, he says, to the newness of the subway, and arises from paint, cement, lubricating oil, hot-boxes and chemical deodorants. The report dwells at length upon the question of dust and shows that there is a large amount of it present and that it is a matter of grave importance. This dust, when analyzed, shows 62.78 per cent. of metallic iron. A microscopic examination shows that the fragments range in size from those that can almost be seen by the naked eye to those one twenty-five thousandth of an inch in diameter. This pulverized iron is mostly due to the grinding of brake shoes amounting to one ton per mile per month. As to bacteria, Mr. Soper found less in the subway than on the street. He criticizes the ballast in front of the stations because it is saturated with oil from the machinery of the cars. He also severely criticizes the existing conditions at the subway stations, and says: "The stations should be cleaned and cared for in a more systematic and thorough manner."

A 16-inch shaper, having extensions for the guides at the front and rear of the column, screw adjustments for length of stroke, and two ratios of gearings (one being 6 to 1 and the other 19 to 1), giving a range of from 8 to 76 strokes per minute, has been brought out by the Rockford Machine Tool Company, of Rockford, Ill.

Personal.

J. K. W. Davenport has become associated with the new industrial engineering department of the Crocker-Wheeler Company, Ampere, N. J. This department is a formal organization of the work in engineering advice in the installation of motors which the company has been doing for several years, and which has so grown as to require this organization.

A. E. Hoermann, mechanical engineer, who has been with Curtis & Company Manufacturing Company, of St. Louis, for several years as chief engineer, intends on December 1 to open an office at 261 Broadway, Rooms 14-15, New York city, as manufacturers' agent, and will make "pneumatic machinery" his specialty. He will represent the above-named company and others in similar lines.

Joseph L. Hummer, retiring general foreman of the special machine and gasolene-engine departments at the Deering Works, International Harvester Company, Chicago, was tendered a farewell banquet on Friday evening, November 17, by the Deering foremen. He was presented with a beautiful clock as a token of their friendship and esteem. December 1, Mr. Hummer takes up the duties of master mechanic at the Studebaker Works, South Bend, Ind. Saturday evening was the occasion of a gathering of the employees of the special machine department named above, in honor of Mr. Hummer. They presented him with two massive leather chairs.

Obituary.

George Robert Stephenson, one of the pioneers of the British railway system, died on October 26 in his eighty-seventh year. Mr. Stephenson was the son of Robert Stephenson and the nephew of George Stephenson, the greatest of English railway builders. He was born

four years before the first rail of the Stockton & Darlington line was laid by his uncle, and during his whole business life he was associated intimately with railway works in various parts of the world.

Business Items.

The Winkley Company, Hartford, Conn., manufacturer of oiling devices for machine tools, engines and automobile work, together with its recent additions to its line of manufacture (it has acquired the Garilus carburetor and the Eureka separator), finds it necessary for it to have larger quarters for manufacturing, and to get nearer to the center of trade in its various lines, it has decided to move its business to Detroit, Mich. This move, it is expected, will take place during the holidays, so that the company will be prepared to fill all orders from Detroit, Mich., on and after January 1, 1906.

In order to adequately care for its continually increasing business the American Blower Company, Detroit, Mich., is erecting a three-story addition to its plant. The building will be of steel and brick construction. The first floor will be used for erecting and testing engines, a very complete new outfit being put in for the latter purpose. The power from engines under test will be absorbed by generators and air compressors. An electric crane will form part of the equipment in this department. The second floor will be used for storing engine parts and painting the completed engines, and the third floor will be utilized for storage purposes entirely.

Manufacturers.

The Fort Wayne (Ind.) Electric Works will build a new foundry.

W. E. Wadsworth, Eureka Springs, Ark., will erect a cold-storage warehouse.

The Cleveland (O.) Twist Drill Company is erecting a new addition to its plant.

The Chas. A. Stickney Company, St. Paul, Minn., will erect a $10,000 factory.

The Puget Sound Sheet Metal Works, Seattle, Wash., will erect a new plant.

The plant of the Edge Tool Works, Gas City, Ind., has been burned; loss, $25,000.

The Regal Gas Engine Company, Coldwater, Mich., is erecting an addition to its factory.

The Baldwin Locomotive Works, Philadelphia, Pa., will erect another large building.

The Waterbury (Conn.) Crucible Company has awarded contract for the erection of an addition.

The machine shop of Joseph Dyson & Sons, Cleveland, O., was burned, entailing a loss of $30,000.

Burtar & Gassmann, architects, Chicago, Ill., are preparing plans for an addition to a foundry.

The Simmons Pipe Bending Works, Newark, N. J., whose plant was burned some time ago, is rebuilding.

The Mechanical Appliance Company, Milwaukee, Wis., has let contract for a new $16,000 factory.

The United States Cast Iron Foundry Company will erect a new foundry at its plant in Burlington, N. J.

The plant of the Bellaire (Mich.) Woodenware Company was destroyed by fire, entailing a loss of $50,000.

The Buffalo Steam Pump Company is erecting a large foundry at its works in North Tonawanda, N. Y.

W. J. Murray, Washington, D. C., recently of the firm of Forsberg & Murray, will erect large machine shops.

The American Blower Company, Detroit, Mich., is building an addition to its engine-manufacturing plant.

Ground has been broken for an electric power-house at Warsaw, Ind., for the Winona Interurban Company.

The Fairbanks Machine Tool Company, Springfield, O., is erecting an addition to its piano-plate department.

William Nichols, of Otter River, Mass., is negotiating for the establishment of a machine shop in Ware, Mass.

The Colonial Foundry & Machine Company, East Norwalk, Conn., has increased its capital stock and will enlarge the plant.

The Landis Tool Company, Waynesboro, Pa., will make extensive improvements at its plant, installing a lot of new machinery.

The Denver & Rio Grande Railroad Company will expend nearly $1,000,000 in installing an electric lighting system.

The Western Machine Company, whose plant at Albia, Iowa, was destroyed by fire recently, will probably locate in Galesburg, Ill.

The Union Twist Drill Company, Athol, Mass., is now building an addition to its plant, and will build another in the spring.

The Buhlen-Huse Ice Company, Memphis, Tenn., has had plans prepared for a cold-storage plant and other improvements.

Plans are being made, it is understood, by the General Electric Company for the construction of another large steel foundry.

The Macon (Ga.) Railway & Light Company will enlarge its plant and power-house, spending over $60,000 in improvements.

The T. B. Laycock Manufacturing Company, Indianapolis, Ind., making bed-springs, has taken out a building permit for a new plant.

Gade Brothers, Iowa Falls, Ia., manufacturers of a self-cooling gasoline engine, will open a branch factory in Windsor, Canada.

Fire in the wire-weaving plant of the Gilbert & Bennett Manufacturing Company, Georgetown, Conn., caused a loss of $50,000.

The W. J. Oliver Manufacturing Company, Knoxville, Tenn., is making extensive preparations for increasing the capacity of its foundry.

The George E. Dow Pumping Engine Company, San Francisco, Cal., has acquired land in Alameda, and, after plant is erected, will move to the latter place.

The National Tank Company, of Dayton, O., has been incorporated to manufacture self-measuring and computing oil pumps for use in garages and groceries.

Fred W. Wild, Jr., 514 East Twenty-sixth street, Baltimore, Md., is in the market for a second-hand planer for planing marble, 36x36 to 50x50, two heads, to plane from 10 to 12 feet.

The Flanjifelt Packing Company has been formed in Utica, N. Y., to manufacture a packing for steam joints, etc., invented by William H. Brownell, who is president of the concern.

The J. S. Turner Manufacturing Company, Lowell, Mass., is putting up another building, which will contain a machine shop for the manufacture of patent worsted roll covering machines.

The Avery Manufacturing Company, maker of agricultural implements, Peoria, Ill., contemplates extensive improvements. A new power-house will be built and the plant equipped with new machinery.

H. H. Dakin, Box 93, Hudson Heights, N. J., is figuring on a small power plant, and would like catalogues of full equipment for a small power-house, furnace and tower for burning suphur, drying kilns, filter press pumps and wood tanks, pipes, valves, etc.

New Catalogues.

Schumacher & Boye, Cincinnati, O. Circulars illustrating and describing the various styles of engine lathes manufactured by this company.

Jeffrey Manufacturing Company, Columbus, O. Catalogue No. 20, describing coal-handling machinery for mines. Illustrated. 6x9, pp. 142, paper.

National Electric Company, Milwaukee, Wis. Bulletin No. 300, illustrating and describing water-wheel type alternating-current generators. 7x10, pp. 12.

Jacobson Machine Manufacturing Company, Warren, Pa. Bulletin "A," illustrating the Jacobson gas and gasoline engines for gasoline, natural gas, manufactured gas and producer gas. 7x10, pp. 7, paper.

Felt & Tarrant Manufacturing Company, 50-56 Illinois street, Chicago, Ill. Catalogue entitled "Rapid Mechanical Calculations," which describes the comptometer adding machine. Illustrated. 5½x7, pp. 16, paper.

The Reversible Tube Cleaner Company, 24-26 Southbridge street, Worcester, Mass. Catalogue describing the "Criss-Cross" boiler tube cleaner for fire, water-tube and sectional boilers. Illustrated. 3½x6, pp. 8, paper.

National Ventilating Company, 1 Madison avenue, New York. Catalogue entitled "Natural Ventilation by the National System." This contains interesting data on the subject and illustrations showing various installations of the ventilator made by this company. 6x9, pp. 64, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

One copy of AMERICAN MACHINIST for June 23, 1904. Rose Polytechnic Institute, Terre Haute, Ind., Librarian.

Concern making special machinery desires contract for further business. Address Box 846, AMERICAN MACHINIST.

Drawings made and ideas developed of automatic machinery, jigs and fixtures. Address Box 76, Station A, New Haven, Conn.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Will buy or pay royalty for good substitute for belt lacing, or will assist inventor. "Leather Belting Manufacturer," Box 867, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

We want built for us a large number of special traction engines to our specifications and drawings, and desire to correspond with a manufacturer who has large and available facilities for such work. An order for ten would be placed at once, with more similar orders to follow. Terms cash. Please address "X and Y," care AMERICAN MACHINIST.

For Sale.

For Sale—10-ton crane, 40 ft. span, rope

drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale by the Inventor—U. S. Patent No. 786,824; will consider partnership proposition with services included. Address "R. C. L.," care AMERICAN MACHINIST.

Inventors have for sale the U. S. patent of a diamond-holder. Advantages: No resetting, diamond cannot be lost, all points can be made use of. Best offer accepted. Box 865, AM. M.

Machine Shop for Sale.—Here is a great opportunity for someone who wants a business of his own. This is a modern plant, located in central New York. Main building, 100x60 ft., two stories, equipped with about 60 high-grade machine tools, including lathes, milling machines, shapers, drills, etc. Plant is adapted for automobile or any high-grade work, and is now running. This plant and business cost more than $50,000, and we can sell it for less than $12,000, if taken promptly. This price includes land, buildings and machinery, also patents, jigs and tools for making a very profitable specialty. To the right parties we can make very favorable terms. William A. Reade & Co., 402 Chamber of Commerce Bldg., Cleveland, Ohio.

Business Opportunities.

Have two patented machine-tool specialties; orders ahead; large profit; want right party to furnish working capital, $5,000; excellent opportunity; immediate profits. Address "Automatic," care AMERICAN MACHINIST.

A prosperous foundry and machine works in Atlanta, Ga., desires to arrange with manufacturers or patentees for the right to manufacture staple articles of steel and iron suitable for sale in the South. Box 787, AM. M.

A consulting engineer, in active general engineering practice, desires to purchase an interest in a suitable manufacturing business, and preferably near Chicago, Ill. Address George W. Scott, 1302 Security Building, Chicago, Ill.

Wanted—Practical accountant and business man as treasurer of an established manufacturing business; must be able to show a successful record as accountant and office man, and invest from $5,000 to $10,000 in stock of company. Address, with full particulars of experience, ability and references, "J. B.," care AMERICAN MACHINIST.

Wanted—An experienced foundryman to join others in the purchase and operation of an established job foundry with an assured tonnage of 100 to 150 tons per month; must be able to show a successful record and invest from $5,000 to $10,000. Address, with full details of experience in mixing metals, managing help, references, etc., "G. P. M.," AM. M.

For Sale—Fine tool business, incorporated in Pennsylvania, for $15,000. Goods sold principally by mail. Will sell one-fifth interest, or more, for cash; balance can be paid out of earnings. Will give entire charge, as advertiser has not time to give it proper attention. This is a splendid opportunity for a practical young men to get into a growing and good paying business. Address "Business," care AMERICAN MACHINIST.

For Sale—A well-established, paying, metal-working plant in important manufacturing center; superior shipping facilities; equipped with best up-to-date machinery; good, substantial, well-lighted brick building and perfect site. Large orders in hand. Price $75,000 complete, or would sell large interest to good business man or capable, active shop superintendent. Reason for selling, advanced age and ill health of proprietor. Full particulars to interested parties on application. Address "Opportunity," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

General manager, with large experience in organizing new and old manufacturing plants in United States and Canada, is open for engagement; technical graduate; age 35. Box 798, AMERICAN MACHINIST.

CONNECTICUT.

Machine shop foreman, open for position after January 1; thorough, practical, reliable, and with proven ability. Box 848, AM. MACH.

Young man, 35 years of age, wants position as foreman or assistant superintendent; 14 years' experience machine construction, stamp bending, cut and draw, redrawing, jig fixture blanking and sub-press dies. Address "T. G.," 88 High st., Waterbury, Conn.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

IOWA.

Chief Draftsman.—A mechanical engineer, especially expert in drafting-room management, at present employed as chief draftsman of a large manufacturing plant in the West, wants position as chief draftsman. Box 849, AMERICAN MACHINIST.

MASSACHUSETTS.

An iron foundry superintendent or foreman, of experience and ability, now employed, wishes to correspond with parties wishing to engage such a party; heavy machinery, engine, press and architectural, and building castings; mixing iron by analysis, loam, dry and green sand. Box 864, AMER. MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 813, AMERICAN MACHINIST.

Machinist, toolmaker; expert developing ideas; experienced foreman. Box 860, AM. M.

As superintendent or manager; expert mechanic solicits correspondence from parties wishing up-to-date, live man; references. Box 845, AMERICAN MACHINIST.

Young man (experience, 1 year superintending, 4 drafting, 3 machine shop) wants position, assistant to foreman or superintendent of manufacturing concern. Box 828, AM. M.

Position as general foreman, by practical toolmaker; up to date on modern tools and factory systems; 15 years' experience, 5 in charge; inventive and designer. Box 861, AMERICAN MACHINIST.

Position as superintendent; experienced and competent in pattern foundry and machine shop; good executive and organizer; well up in labor-saving appliances and modern manufacturing; can produce results; now holding position of responsibility; good reason for seeking change; references. Box 842, AM. M.

Superintendent; hustling, aggressive and systematic; expert at tools, dies and fixtures; modern methods; interchangeable work; economical management; can reduce costs of productions and raise output; will show results at once; can get the work out of help; at liberty in a few weeks. Box 866, AM. MACH.

PENNSYLVANIA.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Expert air compressor and pneumatic tool designer, technical graduate, 7 years' experience, would make change for more favorable offer. Reply to Box 857, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Cost-clerk, for a manufacturing concern in Canada, employing about 500 men; must be able to improve, if necessary, the system in use at present and to take complete charge of the cost department; applicants, to receive consideration, must state age, experience, present place of employment, salary required and when could engage. Address Box 847, AM. M.

CONNECTICUT.

Wanted—A universal milling machine hand; A1 man. Box 853, AMERICAN MACHINIST.

Toolmakers wanted; a number of first-class men for high-grade fixtures, jigs and small-tool work; steady employment. Box 855, AMERICAN MACHINIST.

Diemakers wanted; experienced hands on punching and piercing dies for small brass and steel work; steady employment. Box 854, AMERICAN MACHINIST.

Wanted—A young man, familiar with drafting, to assist superintendent in an iron casting plant; good opportunity for advancement, if capable. Box 856, AMERICAN MACHINIST.

Wanted—At once, two first-class draftsmen, capable of designing machinery for mill work; must be reliable and energetic; in applying, state experience in detail, age and salary desired. Address Box 840, AMER. MACHINIST.

Several first-class, all-around machinists are wanted by firm manufacturing elevators, clay-working machinery, friction clutches, etc.; men capable of doing erecting or repair work when required; steady work for right men. The Eastern Machinery Co., New Haven, Conn.

ILLINOIS.

Wanted—Machine shop foreman; one familiar with hoisting machinery; good salary for good man. Address "B. W.," care AM. MACH.

Wanted—A mechanical engineer to teach machine-shop work in Chicago school, also a mechanical engineer to teach woodwork. Address 5738 Washington ave., Chicago.

INDIANA.

Help Wanted.—Large concern in Middle West, with rapidly increasing business and in process of reorganization, with foundry, machine shops, sheet metal, automobile, woodworking and millwright departments, desires applications from executives, foremen, draftsmen, cost and production clerks and skilled mechanics; none considered but those accustomed to modern organization methods; state experience and salary expected. Address Box 831, AMERICAN MACHINIST.

IOWA.

Wanted—Competent tracers. Murray Iron Works Co., Burlington, Iowa.

MARYLAND.

Toolmakers wanted on automobile work; competent toolmakers; must be first-class men who will appreciate steady employment. Address Pope Manufacturing Company, Hagerstown, Md.

MASSACHUSETTS.

Machinists Wanted—We are increasing our force and need good, all-round men on special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

Wanted—Foremen for brass-finishing department of factory in Cambridge, Mass.; must be experienced, a believer in piece work and capable of turning out goods at a profit. Address A .T. H., P. O. Box 5077, Boston, Mass.

MICHIGAN.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—We still have room for a few more first-class toolmakers. If you have had good experience on making jigs, fixtures and test tools for interchangeable machinery and would like to get a position in an up-to-date tool department, with good wages, write to the Cadillac Motor Car Co., Detroit, Mich.

NEW HAMPSHIRE.

Draftsman, capable of laying out work for detailers in line of steam engines, air compressors, etc.; give experience, references and pay expected. Box 829, AMER. MACHINIST.

Stockkeeper, experienced in modern stock practice in machinery manufacture; capable of taking charge of stock department of large factory; give experience, references and pay expected. Box 830, AMERICAN MACHINIST.

NEW JERSEY.

We are increasing our works and want applications for machinist foremen and machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Brass finisher, experienced in setting up and operating screw machines, Fox lathes, etc.; young man with good ideas, and who is capable of developing into an assistant foreman. Inquire F. H. Lovell, Arlington, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

NEW YORK.

Young draftsman wanted for tracing and detailing. Box 863, AMERICAN MACHINIST.

Wanted—In Rochester, draftsman and patternmakers on special and automatic machinery. Box 858, AMERICAN MACHINIST.

Wanted—Bright young men with mechanical inclinations, to become machinists in special line. Address Box 800, AMER. MACH.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse. N. Y.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Draftsmen wanted for work in Brooklyn, on jigs, fixtures, die work and general shop tools; only experienced men need apply. Address J. S. Co., care AMERICAN MACHINIST.

Wanted—A chemist; one familiar with strength of materials, also the best foundry practice; must be able to recommend material to accomplish certain results. Box 817, A. M.

Draftsmen wanted for work in Brooklyn, on jigs, fixtures, die work and general shop tools; only experienced men need apply. Address Mergenthaler Linotype Co., Brooklyn, N. Y.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Salesman wanted; young man having experience in steel and iron or machinery; to receive attention, state age, experience and salary expected. "Steel Manufacturer," care AMERICAN MACHINIST.

Bright young mechanic, familiar with small fine work, to learn to care for some special machinery in a manufacturing plant; will pay $20 per week, or better, to satisfactory man; non-union preferred. Apply to Box 799, A. M.

Milling machine operators, capable of setting up their own machines, reading blueprints and being able to do first-class tool machine work; if not first-class, do not apply. Address G. M. H., Box 129, 617 6th ave., New York City.

Wanted—General foreman for night shift, by company building air compressors, etc.; in applying, state age, reference, present employers, length of present service and wages expected; all applications treated strictly confidential. Address Box 844, AMER. MACH.

Wanted—Superintendent for factory, including brass foundry, making highest grade plumbing fixtures; a record of ability and successful handling of men is necessary. Address, stating salary expected, the Meyer Sniffen Company, 5 East 19th st., New York.

Wanted—Experienced men for our mechanical engineering department, to specify orders for shop; technical graduates with drafting-room experience preferred; state age, experience, reference and salary expected. Apply, by letter only, Mech. Eng. Dept., Otis Elevator Company, Yonkers, N. Y.

OHIO.

Wanted—Competent foreman for machine shop employing 35 men; state age, nationality, experience, compensation expected and where last employed. Box 862, AM. MACH.

Wanted—In Cleveland, O., man who has installed piece-work system in factory making small sheet-metal stampings of many different articles; state experience and salary desired. Box 850, AMERICAN MACHINIST.

Wanted—In Cleveland, O., foreman to take charge of punch and die makers on metal stampings; state how long and where formerly employed, also salary expected; none but first-class need apply. Box 838, AMER. MACH.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Wanted—One operator Hartford and Cleveland automatic screw machines; steady position for a good man; state age, references and salary expected. Box 851, AMER. MACHINIST.

Erecting foreman; experienced on high-grade machine tools; location, Pennsylvania N. W.; new works; every facility; only competent men with record for accurate work and ability to manage men and work economically need apply; state past employers, capacity and length of service, age, nationality, etc.; letters confidential, returned if desired. Address Box 796, AMERICAN MACHINIST.

TENNESSEE.

Wanted—A draftsman who has had experience in coal mining, contracting machinery and structural iron work; steady position. Wm. J. Oliver Mfg. Co., Knoxville, Tenn.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co..... 99
Acme Machinery Co..... 34
Adams Co., The..... 9
Advance Mfg. Co.....109
Albro-Clem Elevator Co.....103
Almond Mfg. Co., T. R.....107
Alteneder & Sons, Theo..... 98
American Gas Furnace Co... 14
American Pulley Co.....109
American Tool Works Co.... 8
American Tube & Stamping Co. 95
Armstrong Bros. Tool Co.... 88 and 107
Auburn Ball Bearing Co.....104
Automatic Machine Co.....104

Backus Water Motor Co.....100
Baird Machinery Co..... 86
Bair & Gazzam Mfg. Co.....103
Baker Brothers..... 33
Baldwin Chain & Mfg. Co.... 90
Baldwin Steel Co.....108
Ball Bearing Co..... 34
Barnes Co., B. F..... 87
Barnes Co., W. F. & John.... 14
Barnett Co., G. & H...4th Cover
Bartlett, E. E..... 89
Bay State Stamping Co..... 90
Bay State Tap & Die Co.... 86
Beaman & Smith Co., The.. 15 and 106
Becker-Brainard Milling Machine Co..... 23
Bertram & Sons Co., Ltd., John..... 14
Besly & Co., Chas. H..... 91
Bethlehem Fdry. & Mach. Co. 97
Betts Machine Co..... 6
Bickford Drill & Tool Co.... 10
Bignall & Keeler Mfg. Co.... 90
Bilgram, Hugo..... 34
Billings & Spencer Co..... 95
Binsse Mach. Co.....34 and 75
Birdsboro Steel Foundry & Machine Co..... 30
Blaisdell Machinery Co..... 93
Blanchard Mach. Co..... 34
Bliss Co., E. W..... 25
Blount Co., J. G..... 22
Boker & Co., Hermann..... 79
Boston Gear Works.....102
Boynton & Plummer..... 86
Bradford Machine Tool Co... 5
Bridgeford Mach. Tool Works. 16
Bridgeport Safety Emery Wheel Co..... 83
Bristol Co.....4th Cover
Brown-Cochran Co.....100
Brown & Co., R. H.....106
Brown & Sharpe Mfg. Co.... 69 and 4th Cover
Brown Hoisting Mach. Co....105
Buffalo Forge Co.....4th Cover
Builders Iron Foundry..3d Cover
Bullard Auto. Wrench Co.....109
Bullard Machine Tool Co..... 32
Burke Machinery Co..... 90
Bury Compressor Co..... 83
Butler, A. G..... 28

Caldwell & Son Co., H. W...105
Carborundum Co., The..... 30
Card Mfg. Co., S. W..... 17
Carpenter Tap & Die Co., J. M. 86
Case Mfg. Co.....105
C & C Electric Co..... 26
Chambersburg Engr Co..... 87
Chattanooga Machinery Co... 85
Chicago Rawhide Mfg. Co....103
Christensen, N. A..... 83

PAGE

Cincinnati Machine Tool Co..101
Cincinnati Milling Mach. Co.. 7
Cincinnati Planer Co..... 9
Cincinnati Shaper Co.....110
Clark Cast Steel Cement Co..104
Cleveland Automatic Mch. Co. 18
Cleveland Crane & Car Co....105
Cleveland Pneumatic Tool Co. 83
Cleveland Twist Drill Co., The.....4th Cover
Clough, R. M.....104
Coates Clipper Mfg. Co..... 28
Coes Wrench Co..... 23
Colburn Machine Tool Co.... 22
Columbus Machine Co.....100
Cook Co., Asa S..... 90
Cornell, J. B. & J. M.....108
Crescent Forgings Co..... 89
Cresson Co., Geo. V..... 83
Crocker-Wheeler Co..... 26
Crosby Steam Gage & Valve Co..... 17
Cumberland Steel Co..... 90
Curtis & Co. Mfg. Co..... 83
Curtis & Curtis Co..... 83
Cushman Chuck Co.....106
Cutler-Hammer Clutch Co.... 28

Dallett Co., Thomas H.....107
Davis, Rodney.....103
Desmond-Stephan Mfg. Co.... 99
Detrick & Harvey Mach. Co.. 28
Diamond Machine Co...3d Cover
Dill Machine Co., T. C..... 22
Dixon Crucible Co., Joseph...104
Dodge & Day..... 88
Dreses Machine Tool Co..... 81
Drucklieb, C..... 83

Earle Gear & Mach. Co.....102
Eberhardt Bros. Machine Co..102
Eck Dynamo & Motor Works. 28
Electro-Dynamic Co..... 26
Ellis Co., H. G..... 90
Elmes Eng. Works, Chas. F.. 87
Errington, F. A.....107
Evans Friction Cone Co..... 87
Excelsior Needle Co.....108

Fairbanks Co.....30 and 86
Farrel Fdry. & Mach Co....108
Fawcus Machine Co.....104
Fellows Gear Shaper Co.....104
Fenn-Sadler Machine Co.....104
Field, Chas. H.....105
Firth-Stirling Steel Co.....108
Fitchburg Machine Works.... 91
Foos Gas Engine Co.....100
Fosdick Machine Tool Co.... 15
Franklin Mfg. Co..... 97

Garvin Machine Co., The..... 94
Geier Co., P. A..... 28
General Electric Co..... 29
General Mfg. Co..... 88
General Pneumatic Tool Co.. 93
Geometric Tool Co..... 25
Gilmore Electric Co..... 93
Gleason Works.....4th Cover
Goldschmidt Thermit Co.....109
Goodell-Pratt Co..... 90
Gorton Machine Co., Geo..... 87
Gould & Eberhardt..... 73
Graham Mfg. Co..... 87
Grant Gear Works.....102
Gray Co., G. A..... 34
Greaves, Klusman & Co.....105
Greenwald Co., I. & E.....103

Hammacher, Schlemmer & Co. 75

PAGE

Hampden Corundum Wheel Co. 99
Harrington, Son & Co., Inc., Edw..... 95
Hartford Steam Boiler Insp. & Ins. Co.....100
Hendey Machine Co..... 77
Henley Publishing Co., Norman W..... 83
Henry & Wright Mfg. Co.... 24
Heppenstall Forge & Knife Co.105
Hess-Bright Mfg. Co.....101
Hill, Clarke & Co.....84 and 86
Hilles & Jones Co..... 86
Hisey-Wolf Machine Co.....109
Hoefer Mfg. Co..... 14
Hoggson & Pettis Mfg. Co....106
Horton & Son Co., E.....106
Horsburgh & Scott Co..4th Cover
Hunt Co., C. W.....105
Hunt & Co., Robt. W.....100
Hyatt Roller Bearing Co..... 88

Ide & Sons, A. L..... 84
Independent Pneu. Tool Co... 95
Ingersoll Milling Mach. Co... 88
Ingersoll-Rand Co..... 20
International Specialty Co... 99
Iroquos Machine Co..... 89

Jacobs Mfg. Co.....106
Jacobson Mach. Mfg. Co.....100
Jantz & Leist Electric Co.... 28
Jeffrey Mfg. Co., The..... 84
Jenkins Brothers.....104
Johnson Machine Co., Carlyle. 79
Jones & Lamson Machine Co. 12 and 34

Keep, W. J..... 97
Kelsey, Duane J..... 86
Kent & Co., Edwin R.....108
Keuffel & Esser Co..... 98
King Machine Tool Co..... 89

Landis Machine Co..... 87
Landis Tool Co..... 71
Lapointe Machine Tool Co...107
Le Blond Machine Tool Co., R. K.....4th Cover
Le Count, Wm. G.....106
Link-Belt Engineering Co.... 92
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The... 96
Lucas, J. L..... 86
Lunkenheimer Co., The.....104
Lyon Metallic Mfg. Co.....109

McBarron Co..... 90
McCabe, J. J.....31 and 84
McGiehan & Co., C. H.....109
Maris Bros.....105
Marshall & Huschart Mch. Co. 85 and 86
Massachusetts Saw Works....106
Massey Machine Co..... 94
Mechanical Accountant Co.... 88
Merrell Mfg. Co..... 98
Merrill Bros..... 87
Merritt & Co..... 84
Mersfelder Pattern Co..... 85
Mietz Iron Fdry. & Mach. Works, August.....100
Miner & Peck Mfg. Co..... 98
Modern Tool Co..... 28
Moore Co., Franklin.....105
Morse Chain Co..... 96
Morse Twist Drill & Mach. Co. 33
Morton & Co., B. K.....108
Motch & Merryweather Mchry. Co..... 85
Mueller Mach. Tool Co.....107
Mumford Co., E. H..... 24

PAGE

Mutual Machine Co..... 22

National-Acme Mfg. Co.....110
National Corundum Wheel Co. 99
National Separator & Machine Co..... 90
New Britain Machine Co..... 88
New Era Gas Engine Co....100
New Haven Mfg. Co..... 88
New Process Raw Hide Co....103
New Process Twist Drill Co.. 87
Newton Mach. Tool Wks., Inc. 11
Nicholson File Co..... 17
Nicholson & Co., W. H.....107
Niles-Bement-Pond Co..... 84, 111, 112, 113 and 114
Nolte Brass Co.....108
Northern Electrical Mfg. Co.. 26
Northern Engineering Works..105
Norton Emery Wheel Co..... 16
Norton Grinding Co..... 89
Nuttall Co., R. D.....102
Nutter, Barnes & Co..... 88

Obermayer Co., S.....108
Oil & Waste Saving Mach. Co. 98
O. K. Tool Holder Co..... 86
Olds Gasoline Engine Works..100
Owen Machine Tool Co.....106

Parker Co., Chas..... 87
Patterson, Gottfried & Hunter, Ltd.....101
Pawling & Harnischfeger.....105
Paxson Co., J. W.....105
Philadelphia Bourse..... 24
Philadelphia Gear Works....102
Phillips & Sons Co., F. R.... 83
Phoenix Mfg. Co..... 96
Poole Co., J. Morton..... 22
Phosphor Bronze Smelting Co.109
Potter & Johnston Mach. Co.. 77
Pratt Chuck Co.....106
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co... 84

Ransom Mfg. Co..... 81
Reed Mfg. Co..... 87
Reeves Pulley Co..... 25
Reichheim & Co., E. P..4th Cover
Reliance Machine & Tool Co.. 85
Rich, J. & G..... 98
Rivett-Dock Co.....3d Cover
Rivett Lathe Mfg. Co...3d Cover
Robbins, L.....102
Rogers, Boat, Gage & Drill Works, John M..... 92
Rowbottom Machine Co..... 99
Royersford Fdry. & Mach. Co. 96

Safety Emery Wheel Co..... 99
Sames, Chas. M..... 88
Saunders' Sons, D..... 86
Sawyer Gear Works.....103
Schieren & Co., Chas. A.... 1
Schumacher & Boye..... 9
Schwerdtle Stamp Co..... 86
Scranton & Co..... 98
Sebastian Lathe Co..... 28
Sellers & Co., Inc., William.. 34
Seneca Falls Mfg. Co..... 97
Shaw & Co..... 96
Shultz Belting Co..... 99
Sibley Machine Tool Co.....104
Simonds Mfg. Co.....103
Skinner Chuck Co.....106
Slocomb Co., J. T..... 31
Smith & Mills..... 90
Speed Changing Pulley Co... 88
Spicer Universal Joint Mfg. Co..... 97

	PAGE
Sprague Electric Co.	27
Springfield Machine Tool Co.	91
Standard Connecting Rod Co.	100
Standard Engineering Works.	108
Standard Gauge Steel Co.	104
Standard Tool Co.	94
Stanley G. I. Elec. Mfg. Co.	93
Stark Tool Co.	96
Starrett Co., L. S.	33
Steptoe Shaper Co., John.	99
Stevens, F. B.	108
Stoever Fdry. & Mfg. Co.	97
Straley & Hasbrouck	98
Struthers-Wells Co.	100
Sturtevant Co., B. F.	13
Switchboard Equipment Co.	82
Syracuse Raw Hide Co.	103
Taylor-Wilson Mfg. Co.	103
Three Rivers Tool Co.	14
Tindel-Morris Co.	101
Triumph Electric Co.	28
Trump Brothers Machine Co.	106
Underwood & Co., H. B.	96
Union Twist Drill Co.	73
U. S. Foundry & Sales Co.	108
Vandyck Churchill Co.	19
Vitrified Wheel Co.	99
Wallace Supply Co.	83
Ward & Sons, Edgar T.	108
Warner Instrument Co.	98
Warner & Swasey Co.	71
Watson-Stillman Co.	24
Waterbury Farrel Foundry & Mach. Co.	88
Webster & Perks Tool Co.	99
Wells Bros. Co.	31
West Haven Mfg. Co.	4th Cover
Westinghouse Elec. & Mfg. Co.	27
Westmacott Co., J. M.	107
Whitcomb-Blaisdell Machine Tool Co.	21
Whitman & Barnes Mfg. Co.	82
Whitney Mfg. Co.	67
Whiton Mach. Co., D. E.	106
Wiley & Russell Mfg. Co.	90
Wiley & Sons, John.	34
Williams & Co., J. H.	86
Wilmarth & Morman Co.	99
Windsor Machine Co.	83
Winkley Co.	87
Wood's Sons, T. B.	98
Woodward & Powell Planer Co.	96
Worcester Mach. Screw Co.	96
Wormer Machinery Co., C. C.	85
Wright, Harold A.	87
Wyman & Gordon.	4th Cover
Yale & Towne Mfg. Co.	90 and 109

Classified Index of Articles Advertised.

Abrasive Materials

Abasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Arbors

Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects

Dodge & Day, Philadelphia, Pa.

Auctioneers

Shaw & Co., New York.

Ball Bearings

See Roller Bearings.

Barrels, Steel

Lyon Metallic Mfg Co., Chicago, Ill.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Bars, Boring Cylinder

Underwood & Co., H. B., Philadelphia, Pa.

Belt Connectors

Ellis Co., H. G., Clearfield, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Cornell Co., J. B. & J. M., New York.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.
Keuffel & Esser Co., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical

American School of Correspondence, Chicago, Ill.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.

Books, Mechanical—*Cont'd*

Sames, Chas. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters

Burke Electric Co., Erie, Pa.
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Boxes, Tote

Lyon Metallic Mfg. Co., Chicago, Ill.

Brackets, Lamp

Standard Welding Co., Cleve., O.

Broaching Presses

Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Bulldozers

Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.

Calipers

Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Brass and Bronze

Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cornell Co., J. B. & J. M., New York.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer

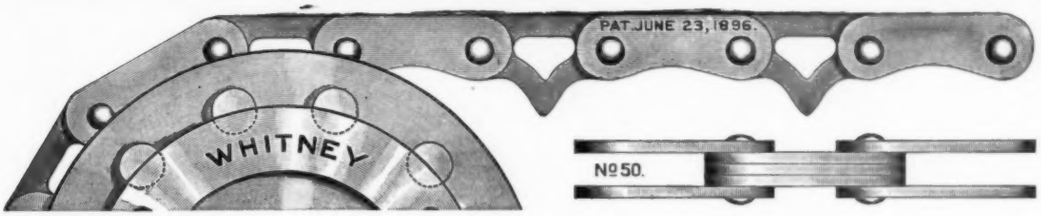
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

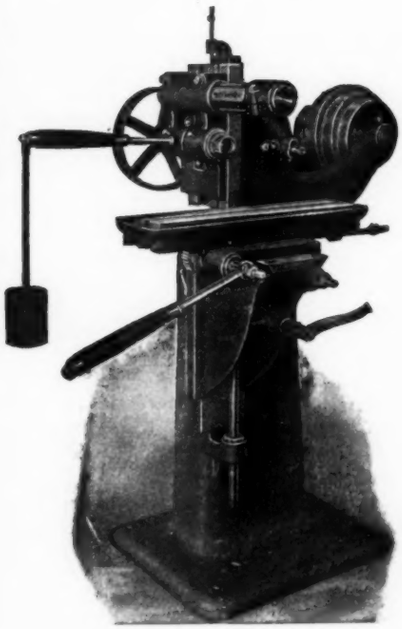
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartfrod, Ct.

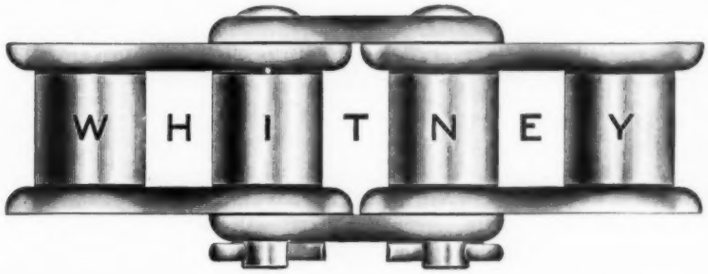
Chisels, Cold

Anderson & Sons Co., Detroit, Mich.

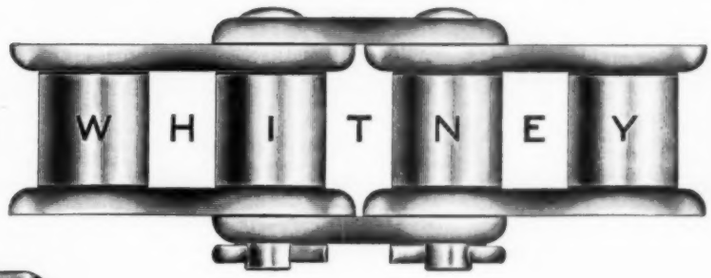


"WIZARD" Chains and Sprockets—Patented

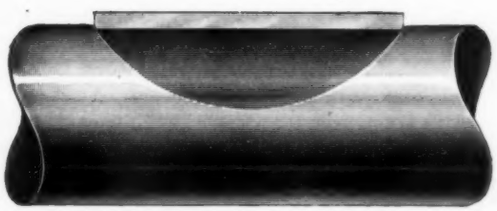




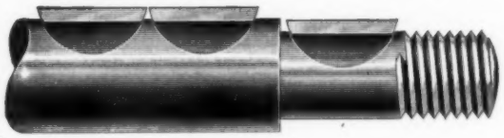
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



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The Woodruff Patent System of Keying

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Gisholt Mach. Co., Madison, Wis.
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Windsor Mach. Co., Windsor, Vt.

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Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
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Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
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Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
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Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

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Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

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General Electric Co., New York.
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Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
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Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
McGlehan & Co., C. H., New York.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold A., New York.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N.Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Couplings, Shaft—*Continued*
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co, Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drawing Materials
Rich, J. & G., Philadelphia, Pa.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
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Prentiss Tool & Supply Co., New York.
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Coates Clipper Mfg. Co., Worcester, Mass.
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Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
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Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
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Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
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Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
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Gould & Eberhardt, Newark, N. J.
Hamilton Mach. Tool Co., Hamilton, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
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Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
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Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.

Engines, Gas and Gasoline *Continued*
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Extractors
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.

Forgings, Steel—*Continued*
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadephia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

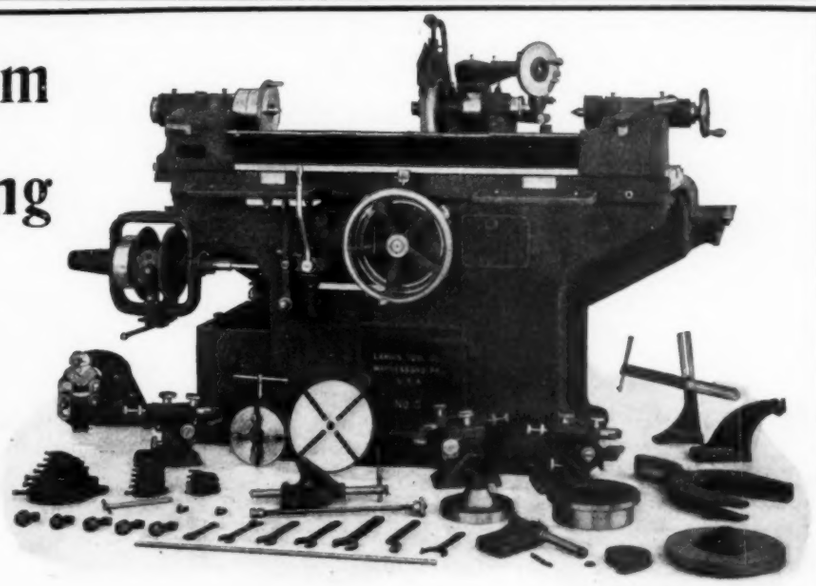
Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.

For Tool Room and Manufacturing



12' Swing, 42' Between Centers.

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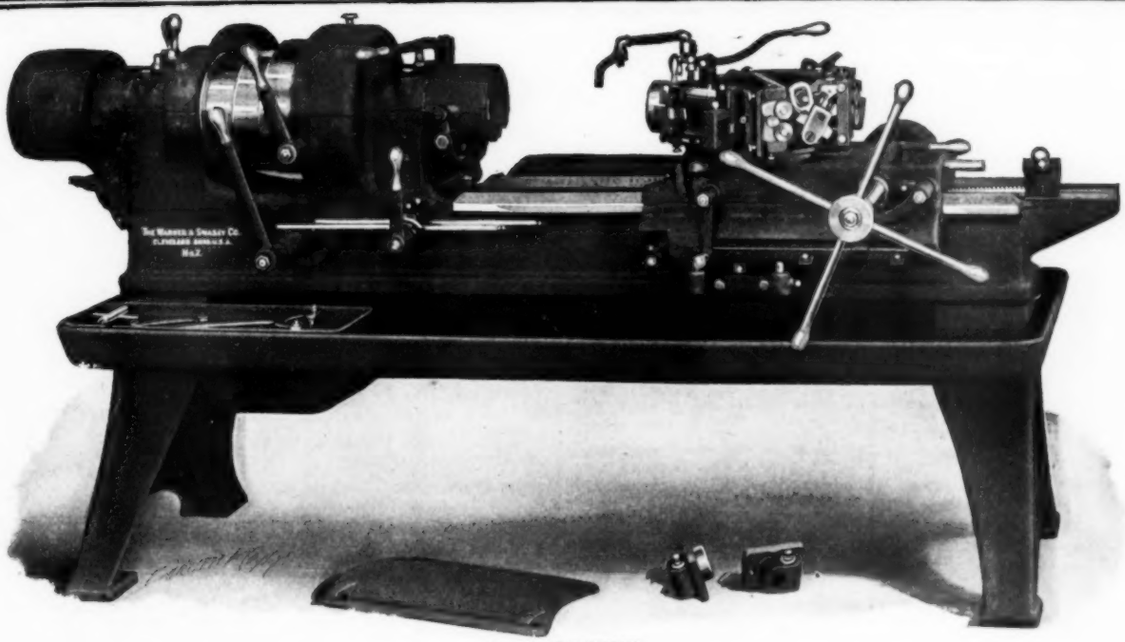

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THREE SIZES:
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Gears, Cut—*Continued*

Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwad Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide

Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.,
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill

Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring

Heald Mach. Co., Worcester, Mass.

Grinders, Portable

Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines

Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & Jno., Rockford Ill.
Besly & Co., Chas. H., Chicago, Ill.

Grinding and Polishing Machines—*Continued*

Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneu. Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels

Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Cleveland Pneu. Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Whitman & Barnes Mfg. Co., Chicago, Il.

Handles, Screw Plate

Standard Welding Co., Cleve., O.

Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water

Sturtevant Co., B. F., Hyde Park, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
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Heating Machines

Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery

Brown Hoisting Mchry. Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric

C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel

Sprague Elec. Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed

Norton Emery Wheel Co., Worcester, Mass.
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Indicators, Speed, Peripheral

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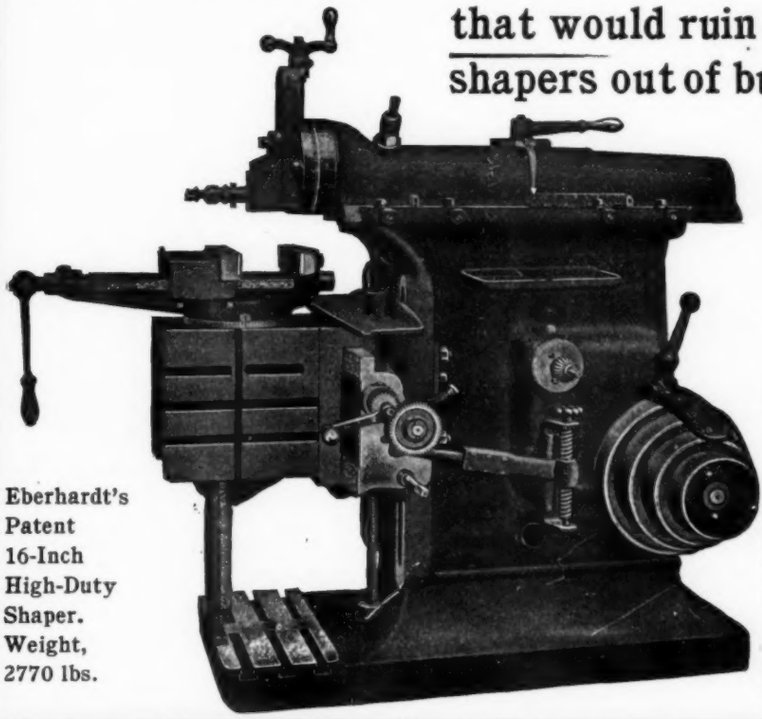

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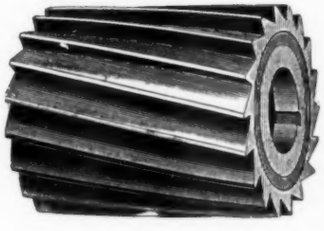

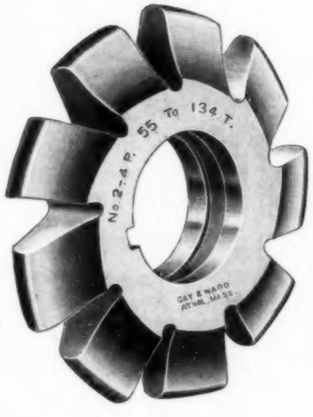

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International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

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Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear
Phillips & Sons Co., F. R., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
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Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Gilmore Elec. Co., So. Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
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Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

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American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.

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Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
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Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
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Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass
Dreses Mach. Tool Co., Cincin., O.
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Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
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Lathes, Wood
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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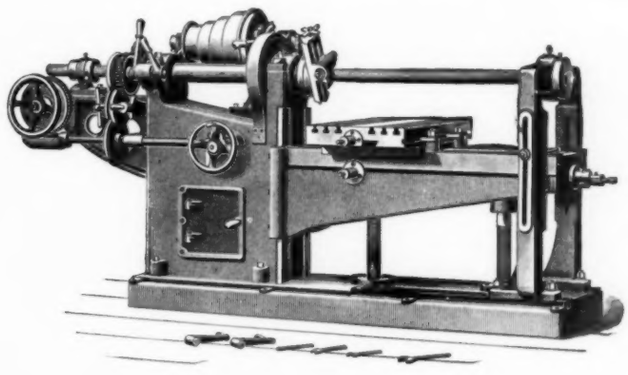

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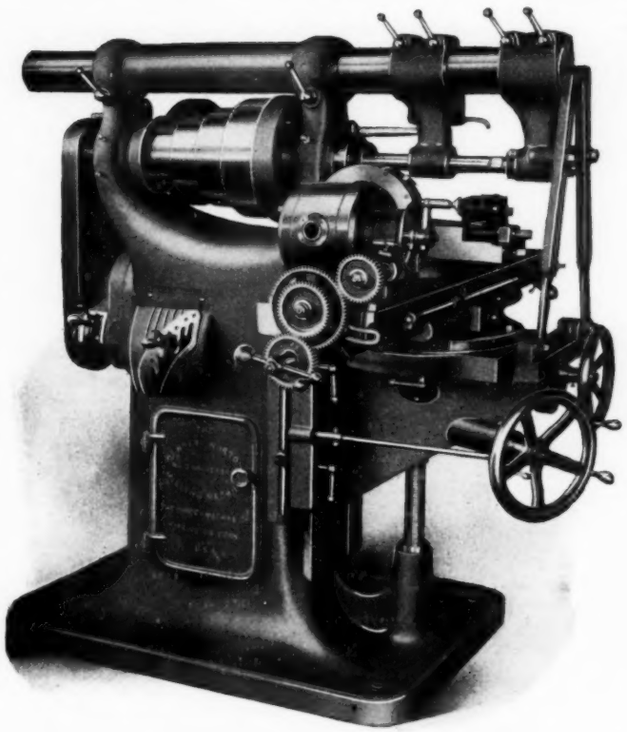

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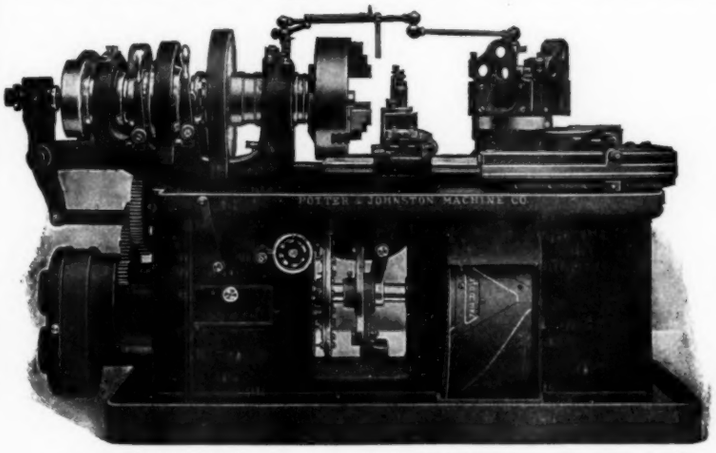

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